

R.T.

# TECHNICAL INSTRUCTION

## R 4

Presto Recording Equipment

BRITISH BROADCASTING CORPORATION  
ENGINEERING DIVISION

# TECHNICAL INSTRUCTION

R<sub>4</sub>

## *Presto Disk Recording Equipment*

### **IMPORTANT NOTICE**

This Instruction replaces Instruction RC.3.  
Please note that all Recording Instructions in  
pre-war and war-time binders are now obsolete  
and should be destroyed.

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EQUIPMENT

# PRESTO DISK RECORDING EQUIPMENT

## SECTION A

### GENERAL DESCRIPTION

#### Introduction

This instruction covers the various types of Presto static disk recording equipment as modified for use by the BBC.

Each recording channel comprises two machines, together with a bay carrying amplifying and switching equipment. A photograph of one such channel appears in Fig. 1. The equipment is capable of recording at either 78 r.p.m. or  $33\frac{1}{3}$  r.p.m. Two slightly different basic types are in use, the 6N and the 8N.

In the first equipments received, two 6N machines were mounted together on a single pedestal. Since this arrangement permitted the transmission of vibration from one machine to the other, later 6N equipments were modified at the time of installation, and each machine was mounted separately; the earlier machines also are being modified similarly as the opportunity arises.

The 8N machines have an improved traverse drive, and are mounted singly on BBC pedestals. With both types, BBC Type-B recording heads replace the original Presto heads.

At centres where more than one Presto channel is installed it is usual to provide a channel-linking system; the function of this is to permit the centralised control of change-overs when two or more channels are recording the same programme.

#### Summary of Equipment

The main types of equipment are listed below. With almost every new installation or major overhaul the opportunity is taken to introduce minor improvements, and for detailed information on a specific channel reference should be made to the channel drawings supplied by Planning and Installation Department or Recording Department.

#### *Type A*

This was the 6N equipment as originally supplied. The two machines, fitted with Presto recording heads, were carried on a single pedestal. Programme circuit connections were made on a P.O.-type jackfield situated on the pedestal below the recording machines. The amplifiers comprised a limiter amplifier Type 41A, two recording amplifiers Type 88A, and a monitor amplifier Type 89A. The amplifier

connections were brought out to a separate American-type jackfield on the amplifier bay.

All Type-A channels have now been modified to one of the types listed below.

#### *Type AB*

This is similar to Type A, but the Presto recording heads are replaced by BBC Type-B heads.

Since the input level to the original limiter amplifier caused overloading of the first stage, the input level is reduced by 12 db, involving a corresponding reduction in the limiting level. The amplifier coding 41A is retained.

The recording amplifiers, Type 88AB, differ from Type 88A in respect of gain/frequency characteristic, phase-reversal circuit and output circuit. (Detailed descriptions of amplifiers appear in Section C.)

#### *Type ALB*

This is a Type-AB channel with the addition of the channel-linking system described in Section D.

#### *Type JB (Fig. 10)*

This consists of a 6N equipment which has been subjected to considerable modification. The recording machines are mounted on separate pedestals, and an enlarged jackfield is provided on the amplifier bay, the switch-and-fuse panel (see Section C) at the bottom of the bay being moved round to the back in order to allow the necessary additional space.

The new jackfield, Type JF/4, carries P.O.-Type-4112B jacks and replaces both the machine-pedestal jackfield and the American-type bay jackfield provided on earlier installations.

A line-up panel, LUP/1, and a line-up key are fitted to facilitate lining-up operations.

#### *Type JLB*

This is similar to Type JB, but with channel-linking equipment added.

#### *Types JB and JLB: Modified Channels*

These have the same circuits as Types JB and JLB (Fig. 10), but the wiring layout is altered to

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### Section A

make it similar to that of Types JC and JLC (Fig. 11).

#### *Type JC (Fig 11)*

The Type JC is a Presto Type-8N equipment with various BBC modifications. The machines, which are fitted with Type-B recording heads, are mounted on separate pedestals, a line-up panel LUP/1 is provided, and all connections are brought out to a jackfield on the amplifier bay.

The limiter amplifier is Type 41AA, the recording amplifiers are Type 88AC and the monitor amplifier is Type 89AA. The main difference between the above amplifiers and earlier types is in the provision

of feed-metering circuits; these terminate in a jack and selector-switch on the face panel.

#### *Type JLC*

This is similar to Type JC, but with the addition of channel linking.

#### *Swarf Removal Equipment*

Certain channels are fitted with suction equipment for the removal of swarf. This equipment, Types SRE/1 and SRE/2, is described in Section E. Swarf removal equipment will eventually be provided in all Presto recording channels.

## SECTION B

### THE RECORDING MACHINE

#### General

The arrangement of the equipment may be seen from Fig. 1, which shows a modified 8N channel with the BBC designation Type JC.

The recording machine is mounted on a rectangular metal plate supported by a rubber seating. The 17½-inch turntable on each machine is coupled by friction-drive to a 1/25th horse-power squirrel-cage motor wound for 115 volts, and transformer-connected to the 230-volt incoming supply. The motor has two stator windings, one supplied direct and the other via a capacitor, the purpose of which is explained in Appendix C of the Recording Training Manual. Due to the presence of flats on the rotor, the motor locks into synchronism with the mains-supply frequency when up to speed, the synchronous speed, with a 50-c/s supply, being 1,500 r.p.m.

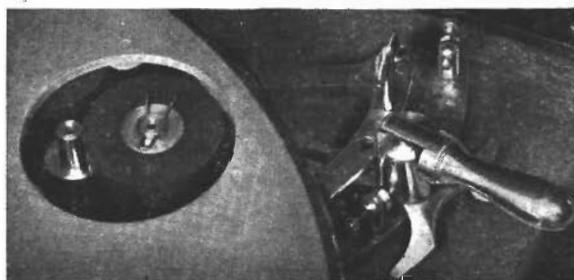


Fig. B.1. Drive Unit

#### Turntable Drive

The same turntable-drive mechanism is employed on all types of equipment, the general arrangement being shown in Figs. B.1 and B.2. The turntable is flanged and the motor shaft is coupled to the inner side of the flange through one of two rubber idler-wheels selected by a speed-change lever.

The end of the motor shaft carries a driving roller having two diameters. When the speed-change lever is in the 33½ r.p.m. position, as shown in Fig. B.1, the smaller-diameter section of the driving roller is coupled to the turntable rim through the right-hand idler-wheel. When the speed-change lever is moved to the 78 r.p.m. position (i.e., to the right), the larger-diameter section of the roller engages with the lower part of the left-hand idler-wheel, the upper part of which engages with the turntable rim. In the

central position of the speed-change lever the idler-wheels are freed from both the driving roller and the turntable, thus avoiding the formation of flats on the idler-wheels when the machine is not in use.

The speed-change lever is fitted with a locking device, which holds the lever in the operated position. When in this position an extension on the lever depresses the domed top of a plunger, visible in Fig. B.2, which actuates the mercury-barrel type motor switch.

#### Traversing Assembly

The traversing assemblies employed with the 6N and 8N equipments are basically similar, the main differences being in the recording-head mounting and the method of engaging the traverse. Front and rear views of the original 6N assembly are shown in Figs. 2 and 3. A view of the Type-8N traversing

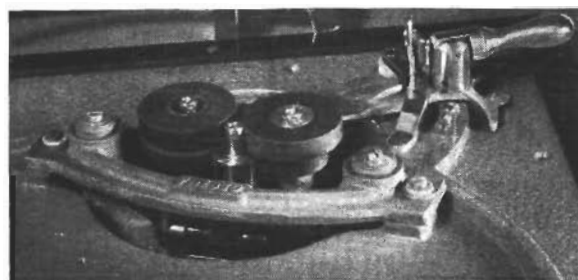


Fig. B.2. Details of Drive and Speed-change Mechanism

assembly after modification by the BBC is given in Fig. 4; this modified assembly is given the coding 8NA.

#### Type 6N (Figs. 2 and 3)

Referring to Fig. 2, the assembly consists essentially of traversing and supporting bars (30) and (31) and lead-screw (8), held between two end-castings and jointly supporting a carriage (3) which is driven by the lead-screw from right to left along the bars. Also mounted between the end-castings are a scale and a radius compensator unit (Fig. 3).

One end of the traversing assembly is attached to the machine bed-plate by means of a swivelling pillar (45) terminating in an elbow joint (9). The other end carries the driving mechanism, which is

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### Section B

protected by a housing (38) and is driven by a boss (36) which fits over the locating and driving pins on the turntable. The boss also serves as a disk clamp.

The traverse-driving mechanism consists of a worm (39) and worm-wheel (40), the latter driving the lead-screw (8) through a ratchet inside the worm-wheel. The lead-screw can be removed by unscrewing the knob (11) and sliding the hand traverse shaft outwards.

Two different lead-screws are supplied for each machine, one providing a pitch of 120 grooves per inch and the other 104 grooves per inch. The carriage is engaged with the lead-screw by rotating and lowering the knurled knob (10). This operation lowers a metal blade (13) into contact with the thread of the lead-screw and engages the drive. In addition to the normal drive, provision is made for traversing the carriage by means of a hand-traverse wheel (12). This operates in one direction only (clockwise as viewed from the right-hand side of the machine), due to the ratchet device contained in the worm-wheel. The hand-traverse wheel has two uses; when the machine is stationary, it can be used to set the head to any desired position over the disk, and when the machine is in motion, it can be used to overrun the normal drive for scrolling purposes.

For the removal and replacement of disks, the traversing assembly is swung clear of the turntable by means of the hand grip (29) and placed on the rest pedestal.

#### *Type 8NA (Fig. 4)*

Except for the method of traverse engagement and for the recording-head mounting, the Type-8NA traversing assembly is similar to the Type 6N.

The traverse drive is controlled by a lever which presses on an extension of the pivoted traverse blade. When the lever is lowered, the traverse blade is held in engagement with the lead-screw by the pressure of a spring; when the lever is raised, the traverse blade is removed from contact with the lead-screw and the traverse drive is thereby disengaged. In Fig. 4 the traverse-engaging lever is shown in the lowered (i.e., engaged) position, being visible to the right of the recording-head raise-lower lever.

### **Recording-head Mounting**

#### *Type 6N (Figs. 2 and 3)*

In the 6N equipment the recording head is carried on a U-shaped slotted bracket (32), provided with a hinged joint and mounted in pivots on the carriage. The bracket has an extension arm (15) which

engages the cam-shaped end of the raise-lower lever (16). An oil dash-pot (17) is fastened to the recording-head bracket on the right-hand side of the head. The plunger (18) in the dash-pot is attached to the side of the carriage. The function of the dash-pot, as explained in the Recording Training Manual, Section 2.16.4, is to damp out any oscillation of the head about its pivots.

Depth of cut is controlled by the tension of a spring (7) suspending the recording-head bracket. The tension in the spring is adjusted by means of a small knurled nut (19).

The position of the recording-head on the bracket may be adjusted by slackening off two screws attached to the head and passing through the slots in the bracket; the slots then permit the head to be moved up or down or rotated in the plane of the bracket as may be required to secure correct alignment. The head may also be tilted backwards or forwards by loosening the screw (33) securing the hinged joint on the bracket.

#### *Type 8NA (Fig. 4)*

The recording head is carried by a folding bracket on an arm pivoted beneath the carriage (Fig. B.3);

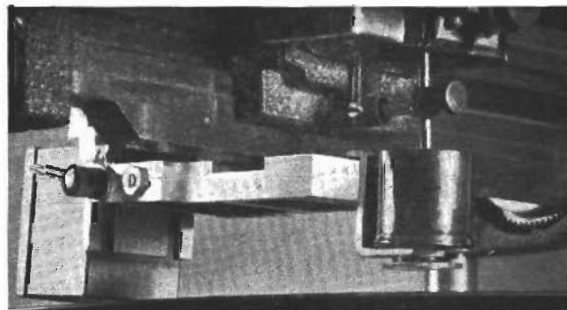


**Fig. B.3. Recording-head Mounting on Type-8N Machine**

at the other end of this arm is the dash-pot. The downward pressure at the cutter-point, and hence the depth of cut, is controlled as on the Type-6N equipment by adjustment of the supporting-spring tension. The rake of the cutter (i.e., the angle between its shank and the plane of the disk) is adjustable by means of the large knurled-headed screw visible at the top of Fig. 4; rotation of this screw raises or lowers the pivots of the recording-head arm by moving a slide in vertical guides on the front of the carriage casting.

Two horizontal knurled-headed screws are fixed

near the base of the recording-head bracket, one on either side of the head; the right-hand screw, with a miniature tommy-bar attached, is visible in Fig. 4 and also, seen from behind, in Fig. B.3. By loosening these screws the bracket may be unfolded, opening out on hinges to facilitate inspection of the underside of the head or replacement of the cutter.

#### Radius Compensator Slider Unit (Fig. 3)

The slider unit operates in conjunction with a bay-mounted variable equaliser unit, in which it provides the variable components. The purpose of the equaliser is to increase the high-frequency response of the recording chain progressively as the recording head moves toward the centre of the turntable. The reasons for using radius compensation are explained in the Recording Training Manual, Sections 2.8.2, 2.9 and 2.11.

Referring to Fig. 3, the slider barrel (28) is attached to the recording-head carriage so that, as the carriage moves across the disk, each of the fingers (26 and 27) makes contact with a row of studs and a central bar. Connected to the studs is a series of resistors forming part of the equalising network. This network is described in Section D, and a wiring diagram of the radius compensator slider unit is given in Fig. 12.

#### Auxiliary Equipment

Each machine has a pillar to hold a portable microscope used for groove inspection. The microscope, which is transferred from one machine to the other as required, is supported on the pillar by a movable collar the height of which can be adjusted to allow the microscope to be brought into use on either machine without re-focusing. Attached to

the microscope is a reflector carrying a 6-volt lamp supplied from a transformer beneath each machine. One terminal of the lamp and one side of the transformer secondary are connected together through the microscope pillar and the bed-plate, and the circuit is completed through a pin-and-socket connection and a switch adjacent to the pillar.

An E.M.I. Type-12 pickup is fitted to each machine for checking purposes. The comprehensive-checking circuit is described in Section D.

Some form of swarf-collecting device is provided on all machines. This may be either the suction equipment described in Section E, or a brush resting on the disk surface.

#### Machine and Pedestal Wiring (Fig. 5)

The wiring layout where two machines are mounted together on a single pedestal (channels AB \* and ALB) is given in Fig. 5.

The wiring of separately mounted machines follows one of two arrangements; in the earlier installations (channel JB) the programme wiring follows Fig. 10 and the power wiring is an adaptation of that shown in Fig. 5. The wiring of later installations (channels JB *modified* and JC) is differently arranged. In these channels the machine pedestal is fitted with a detachable back which, on removal, exposes a hinged connector-panel carrying plug-and-socket connections for the reproducing head, radius compensator unit, recording head and mains supply to the turntable motor. From this panel leads are taken to the rear of the amplifier bay. A mains-isolating switch for the machine is situated adjacent to the connector-panel, and mounted behind the panel are the microscope transformer and the pickup attenuator or transformer-attenuator unit.

\* The various types of channel are listed at the end of Section A.

## SECTION C

## AMPLIFIER AND CONTROL BAY

**General Description**

The amplifier and control bay (Fig. 1) carries the following apparatus:

Limiter amplifier,  
 Equaliser panel, with radius compensation equalisers,  
 Control panel,  
 Jackfield,  
 Monitor amplifier,  
 Recording amplifier No. 1,  
 Recording amplifier No. 2,  
 Switch-and-fuse panel. (On certain 6N equipments this item is fitted at the rear of the bay.)

In Type-6N channels the limiter amplifier is a 41A, the monitor amplifier is an 89A and the recording amplifiers are Type 88AB. In Type-8N channels the limiter amplifier is a 41AA, the monitor amplifier an 89AA and the recording amplifiers 88AC.

**Limiter Amplifier 41A (Fig. 6)***General Description*

Limiter amplifier 41A is basically a voltage amplifier, but incorporates an automatic gain-control circuit which restricts the peak voltage of the signal being recorded to a maximum of 8 db above that at line-up level.

The intrinsic gain of the amplifier under non-limiting conditions is approximately 49 db, but as during recording an attenuation of 21 db is introduced at the input, the working gain is only about 28 db. In channels not fitted with line-up key and line-up panel (see Section D), a 21-db loss-pad, mounted inside the amplifier bay adjacent to the 41A, is inserted in the circuit wiring preceding the input to the limiter amplifier.

The amplifier includes a built-in power supply with an h.t.-voltage regulating circuit.

*Amplifying Circuit*

This comprises three push-pull resistance-capacitance coupled stages. The first stage employs two heptode valves of the type sometimes used as frequency-changers in super-heterodyne receivers, the programme signal being applied to what are normally the oscillator grids. Bias for the valves is obtained from R7 and R8; R7 is variable and provides a balance adjustment. A saw-tooth oscillator (p. 34, Fig. G.1) is provided for connection to the *Oscillator* jack (Fig. 6) during balance testing.

The second stage employs two pentodes, and the third stage two triodes. Voltage feedback from the

output of the third stage to the input of the second stage is effected by means of cathode injection through R25, C6 and R26, C7. Current feedback within the final stage is obtained by omitting the normal shunt capacitor from the common bias resistor, R22. An 8,000-ohm pre-set variable resistor, R27, is connected between h.t. positive and the cathodes of V5, V6. This resistor functions mainly as a bleeder, but also stabilises the bias voltage across R22.

*Gain-control Circuit (Fig. C.1)*

The double-diode rectifier, V7, is negatively biased from the h.t. supply through a potential divider, R34, R31, and also receives a signal voltage from the output stage of the amplifier. As long as the biasing voltage is sufficient to counteract the signal voltage, the rectifier is inoperative, but if the peak signal voltage exceeds the bias, the rectifier conducts, and a charge appears on capacitor C1. This charge leaks away gradually through R1–R6, but continues to be replaced via the rectifier as long as the excess signal voltage persists.

The rate of leakage, and hence the rate at which the charge disappears when the signal voltage becomes less than the biasing voltage, is determined by the discharge-time constant of the circuit. The time constant of any R-C circuit is the time taken for the potential of the capacitor, after receiving a charge, to fall to  $1/e$  (0.368) of the initially produced value, and is given in seconds by the product of the capacitance expressed in farads and the resistance in ohms. In the present circuit the discharging time is controlled by the value of C1 and the tapping of the series resistance network R1–R6 selected by the *Recovery Time* switch.

When C1 becomes charged, the rectified signal voltage is applied to the control grids of V1, V2, and reduces the gain of the first stage in proportion to the excess signal voltage. The value of signal voltage required before the rectifier will conduct is determined by R31, and the value of this resistance has been chosen so that limitation occurs if the output level of the amplifier exceeds +16 db.

The degree of limitation is indicated on the limiter meter which is situated in the centre of the control panel below the amplifier. This meter has a scale with a right-hand zero, and is shunted across part of the anode load resistance of V1. Under non-limiting

conditions the meter takes maximum current and therefore reads zero, but when limitation occurs the anode current of V1 is reduced, and the instrument pointer moves to the left over the scale which is graduated according to the compression in db.

A zero adjustment for the limiter meter is provided by the 0/500-ohm potentiometer, R10, which acts as a variable shunt for the meter.

~~in the first stage.~~ The above arrangement is employed for meter zero adjustment in the 41A amplifier as originally installed. When, however, a channel becomes due for major overhaul, it is now usual to fit an adjustable meter shunt as employed on the 41AA amplifier described later.

The second potential divider, comprising R39, R40 and R41, provides the required grid voltage for V9. The voltage between the grid and cathode of V9 is conditioned by the difference between the voltage across the neon (which is constant) and the voltage between the slider of R40 and earth.

If, during limitation, for example, the amplifier feed is reduced, the supply voltage will tend to rise above 275. Since this supply is also connected to R41, the potential at the slider of R40 will also rise, thus making the grid of V9 more positive with respect to cathode and increasing the anode current of V9.

Now the anode of V9 is connected to the load

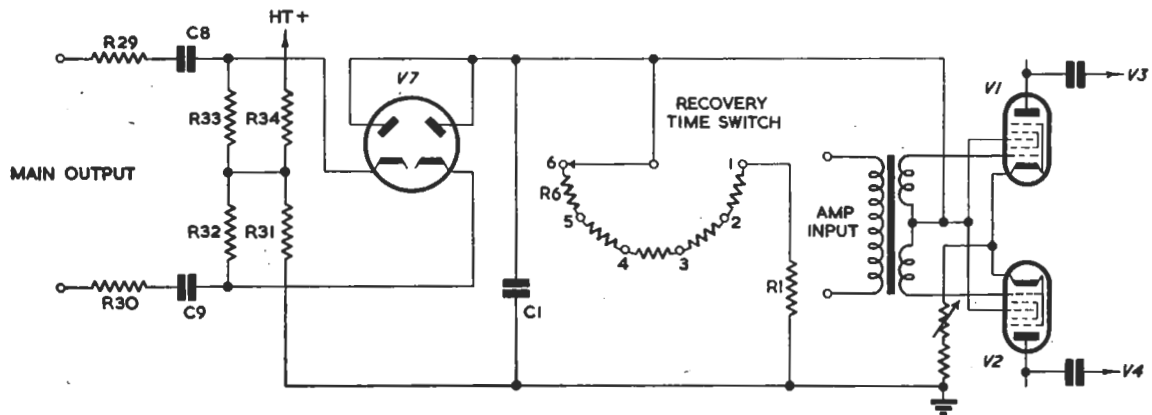


Fig. C.1. 41A Amplifier: Gain-control Circuit

#### 41A Voltage-regulating Circuit

This circuit is shown in Fig. C.2. The output from the mains rectifier V11 is fed after smoothing to the anode of V10, the cathode of which is connected to the double-diode rectifier, V8, and to the pentode, V9. These two valves, together with the neon stabiliser, are in series and shunted across the h.t. supply.

The circuit will first be considered under working conditions, i.e., after the valve heaters have warmed up and the amplifier is taking normal current.

#### Working Conditions

The normal h.t. voltage required by the amplifier is 275 volts, measured between the cathode of V10 and h.t. negative. Across this 275-volt supply are two potential dividers.

The first of these, consisting of V8, R36, R37 and the neon stabiliser provides the control valve V9 with its correct anode, screen and cathode working voltages.

resistor R42 and also to the grid of V10. When, therefore, the anode current rises the anode voltage decreases, thus making the grid of V10 more negative with respect to cathode, and hence decreasing the current through V10. In this way, the supply voltage at the cathode of V10 is reduced more nearly to its original value of 275 volts.

Thus, under working conditions, V8 merely functions as a low-impedance path in shunt with R35.

#### Delayed Control Conditions

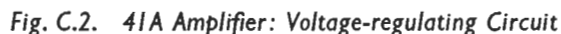
The conditions obtaining immediately after switching on will now be considered.

It will be observed that both the rectifier, V11, and the triode, V10, are directly heated, whereas the amplifying valves and also V8 and V9 are indirectly heated.

If no precautions were taken the amplifier, immediately after switching on, would be supplied with an h.t. voltage of approximately 400 volts,

thereby causing risk of damage to the amplifier. This risk is averted as follows: since V8 is indirectly heated, it will not pass anode current before the amplifying valves are heated and the voltage at the

In addition to its main function, the voltage regulating circuit provides additional smoothing, since any residual mains ripple which has not been



As the value of R35 is relatively high, the voltage at the junction of R35, R36, will be low compared with that at the cathode of V10. Now this lower voltage is fed through R42 to the grid of V10. Therefore the potential at the grid of V10 is much lower than that at its cathode and hence strongly opposes the current path through V10, keeping the voltage at the cathode low. When the heater of V8 warms up, the impedance of V8 is reduced to a low value and the valve behaves as a diode, short-circuiting R35. The circuit now functions in the manner previously described.

The h.t. supply to the amplifier can be measured at the positive terminal of the limiter meter, Fig. 6. Adjustment can be made by means of R40, which is a variable potentiometer mounted under the chassis. With this potentiometer turned fully clockwise, the h.t. supply is at maximum and a voltage of 290-320 should be obtained. If the reading is slightly below 290 volts, a faulty V11 or V10 is indicated and if seriously below 290 volts, for example 200 or less, a faulty V8. If no control is obtained

by varying the potentiometer, either V9 or V10 is faulty, or the neon stabiliser is not functioning correctly. If correctly placed, the glow in the neon should be concentrated on the central electrode. If after adjustment to 275 volts excessive hum is present, the smoothing circuit may be suspected.

The potentiometer should be rotated in an anti-clockwise direction until the reading is reduced by 20 volts, or to 275 volts, whichever is the lower value. This adjustment is important, since unless effective control is introduced, the amplifier may produce excessive mains hum. Additional measurements can be made with advantage as follows (using a Universal Avometer or Avominor):

At cathode of V11, 400–430 volts. If below 400 volts, a faulty V11 or C12 is indicated.

At anode of V10, 370–400 volts. A reading below 370 volts indicates faulty smoothing or excessive load.

### Valve Data

| Valve                                                     | Anode<br>Volts | Anode<br>Current<br>mA | Screen<br>Volts | Screen<br>Current<br>mA | Fil.<br>Volts | Fil.<br>Amps |
|-----------------------------------------------------------|----------------|------------------------|-----------------|-------------------------|---------------|--------------|
| Stage 1<br>2 6L7's or<br>1612's                           | 106            | 1.7                    | 45              | 1.9                     | 6.3           | 0.3          |
| Stage 2<br>2 6SJ7's                                       | 32             | 0.85                   |                 | 0.3                     | 6.3           | 0.3          |
| Stage 3<br>2 6J5's                                        | 270            | 7.5                    |                 |                         | 6.3           | 0.3          |
| Side Chain<br>Diode V7<br>6H6                             |                | (Bias 25 V)            |                 |                         | 6.3           | 0.3          |
| Voltage Regu-<br>lator Protec-<br>tion Diode<br>V8<br>6X5 | 300            |                        |                 |                         | 6.3           | 0.3          |
| Voltage Regu-<br>lator Control<br>Pentode V9<br>6SJ7      | 20             |                        |                 |                         | 6.3           | 0.3          |
| Voltage Regu-<br>lator Control<br>Triode V10<br>2A3       | 400            |                        |                 |                         | 2.5           | 2.5          |
| Mains Rectifier<br>5Z3                                    |                |                        |                 |                         | 5.0           | 3.0          |

*Note:* Anode and screen voltages measured between points indicated and frame with Universal Avominor, using 500-volt range.

### Supplies

H.T. Supply, 430 V across C12.

Total feed including R27, approximately 60 mA.  
Power consumption, 0.35 amp at 230 V.

### General Data

#### Impedances

|               |                               |
|---------------|-------------------------------|
| Normal source | $Z = 600 \Omega$              |
| Input         | $Z = 500 \Omega$ at 1,000 c/s |
| Output        | $Z = 110 \Omega$ at 1,000 c/s |
| Normal load   | $Z = 550 \Omega$              |

### Test Data

#### 600-ohm Test Gain

Test Condition 1: Non-limiting Condition:

Tone source sending level:  $-41$  db

Gain at 1,000 c/s,  $G_1 = 49$  db

Test Condition 2: Limiting Condition:

Tone source sending level:  $-29$  db

Gain at 1,000 c/s,  $G_2 = 45$  db

#### Frequency Response

50–10,000 c/s:  $\pm 1$  db relative to 1,000 c/s

#### Output Level under Limiting Conditions

+ 16 db (approx.)

### Limiter Amplifier 41AA (Fig. 6)

This amplifier is used with Presto recording equipment Type 8N. It is similar to the 41A, but with the following modifications:

- The cathode circuits of valves V3 to V6 are altered to allow the valve cathode currents to be checked via a feed-meter jack and selector switch, positions C to F on this switch corresponding to valves V3 to V6 respectively. The meter readings which indicate correct operating conditions when an Avometer Model 40 is connected to the feed-meter jack are given in the valve data which follow. These readings are arbitrary, and depend on the value of the Avometer resistance on the 12-mA d.c. range and on the meter shunts in the cathode circuits of the amplifier.
- The *Recovery Time* switch has five positions instead of six.

the amplifier face panel, and is used as the *Adjust Zero* control for the meter. The potentiometer R7, in the cathode circuit of V1, V2, can then be adjusted solely with reference to the correct operating condition for the valves.

- The *Recovery Time* switch has five positions instead of six.

## INSTRUCTION R4

### Section C

#### Valve Data

| Valve                                                  | Anode<br>Volts | Screen<br>Volts | Cathode<br>Volts | Cathode<br>Current<br>mA | Fil.<br>Volts | Fil.<br>Amps |
|--------------------------------------------------------|----------------|-----------------|------------------|--------------------------|---------------|--------------|
| Stage 1<br>2 6L7's or<br>1612's                        | 120            | 50              | 1.0              | 2.5                      | 6.3           | 0.3          |
| Stage 2<br>2 6SJ7's                                    | 40             | 32              | 1.6              | 1.0                      | 6.3           | 0.3          |
| Stage 3<br>2 6J5's                                     | 270            |                 | 9.8              | 4.0                      | 6.3           | 0.3          |
| Side Chain<br>Diode V7<br>6H6                          | (Bias 25 V)    |                 |                  |                          | 6.3           | 0.3          |
| Voltage Regu-<br>lator Protec-<br>tion Diode V8<br>6X5 | 300            |                 |                  |                          | 6.3           | 0.3          |
| Voltage Regu-<br>lator Control<br>Pentode V9<br>6SJ7   | 20             |                 |                  |                          | 6.3           | 0.3          |
| Voltage Regu-<br>lator Control<br>Triode V10<br>2A3    | 400            |                 |                  |                          | 2.5           | 2.5          |
| Mains Rectifier<br>5Z3                                 |                |                 |                  |                          | 5.0           | 3.0          |

**Note:** Voltages measured between points indicated and frame. Measurements taken on Avometer Model 40, voltages on 1,200-volt d.c. range, except cathode voltage, which is taken on 120-volt d.c. range. Cathode currents measured on 12-mA d.c. range, using feed-meter jack for stages 2 and 3.

#### Other Data

As for limiter amplifier 41A.

#### Equaliser Panel

The panel carries switches for the two equalisers which provide radius compensation for the two recording machines. The switches control the frequency at which maximum equalisation takes place, and have three settings, marked respectively *Off*,  $33\frac{1}{3}$  and 78.

A detailed description of the radius compensation circuit is given in Section D.

#### Control Panel

##### General

The panel carries the necessary meters, switches and potentiometers for controlling and monitoring the recording. It also carries the line-up key and channel-linking key where fitted.

##### Limiter Meter

This meter is mounted in the centre of the control panel. It is connected across a resistor in the anode circuit of V1 in the first stage of the limiter. The meter scale is calibrated from right to left in db of compression, and in the absence of a signal the meter

should indicate 0 db. An *Adjust Zero* control is provided on the limiter face panel.

##### Output Meters

These meters are placed one on either side of the limiter meter, and are connected across a separate winding on the output transformer of each recording amplifier. The meters are calibrated in db with a centre zero, and indicate the level applied to each recording head on the application of line-up tone.

A small ivory tab is provided below each meter. On this should be written the correct line-up level for the corresponding recording head.

##### Recorder Input Switch

This is a three-way Yaxley-type switch, and is mounted on the left-hand side of the control panel below the meters. It connects the limiter output to the recording chain associated with either machine or, in the central position, to both recording chains in parallel.

The circuit may be seen from Figs. 10 and 11, in which the switch is designated SW 1. Where more than one channel is installed at a given centre, the switch connections may be modified for channel linking (Fig. 13), the details of which are given in Section D.

##### Monitor Input Switch

This also is a three-way Yaxley-type switch, and is mounted on the right-hand side of the control panel. It connects the input of the monitor amplifier to the output of either pickup or, in the central position, to the incoming programme line.

##### Line Monitor Level Attenuator

This is a pre-set variable attenuator network. The control is situated on the panel between the recorder input switch and the monitor input switch, and enables the level from line to be adjusted to the same value as that from the pickups.

##### Limiter Input Control

This is the main level-setting control for the whole channel, and consists of a variable attenuator with 24 tapping studs. The loss at the first stud is infinity; the range of control covered by the remaining studs is 44 db, in steps of 2 db per stud.

##### Recording Chain Attenuators

Two of these attenuators are provided, one for each machine. They are similar in construction to the limiter input control, and are mounted on either

side of it. The controls are little used in BBC practice, and are normally set for minimum attenuation.

### *Line-up and Channel-linking Keys*

These are horizontally mounted lever-keys, and are fitted immediately below the limiter meter in the centre of the control panel. They are provided in certain channels only, as explained in Section D.

### **Bay Jackfield**

This may be any one of three types:

- (i) American type, with two rows of 12 dual jacks. The plugs used with these jacks have two pins each, and are provided with tip and sleeve contacts only. The plugs must be used in a uniform manner to maintain proper wiring sequence. For consistency they should be inserted so that the white spot is uppermost or the serrated edge to the right.  
This type of jackfield is fitted in channels Type AB and ALB, and provides access to amplifier inputs and outputs and other intermediate points in the recording chain. (An additional jackfield is fitted to the machine framework. The programme lines are connected to this latter jackfield with tie lines connecting the machine and amplifier bay jackfields.)
- (ii) BBC type, with four rows of twenty P.O. Type-4112B jacks. All connections, including programme lines, appear on this jackfield, which is fitted in channels Type JB, (Fig. 10) and JLB.
- (iii) BBC type, but of American manufacture, and provided with four rows of 24 jacks. This jackfield is similar to (ii), the extra jacks being used merely as parallels, or else left unwired. It is fitted in channels Type JC (Fig. 11) and JLC.

### **Monitor Amplifier 89A (Fig. 7)**

Monitor amplifier 89A is used with Presto recording equipment Type 6N. It is a high-gain amplifier consisting of three resistance-capacitance coupled stages with transformer input and output. Negative voltage feedback is applied by cathode injection from the output of the third stage to the input of the second stage.

The output transformer has two secondaries, providing an output impedance of either 135 ohms or 1.2 ohms at 1,000 c/s. The high-impedance output is taken to a test-jack, labelled *Mon. Amp. Out* (500  $\Omega$ ); the low-impedance output is connected to the loudspeaker speech-coil via another jack, labelled *Mon. Amp. Out* (2  $\Omega$ ).

The power supply unit is incorporated within the amplifier.

### **Valve Data**

| Valve                           | Anode<br>Volts | Anode<br>Current<br>mA | Screen<br>Volts | Screen<br>Current<br>mA | Fil.<br>Volts | Fil.<br>Amps |
|---------------------------------|----------------|------------------------|-----------------|-------------------------|---------------|--------------|
| Stage 1<br>2 6J7's              | 100            | 0.9                    | 30              | 0.2                     | 6.3           | 0.3          |
| Stage 2<br>2 6SJ7's             | 76             | 0.9                    | 40              | 0.25                    | 6.3           | 0.3          |
| Stage 3<br>2 6L6's or<br>1622's | 345            | 60                     | 250             | 3.5                     | 6.3           | 0.9          |
| Rectifier<br>5Z3                |                |                        |                 |                         | 5.0           | 3.0          |

*Note:* Anode and screen volts measured with Universal Avomitor, using 500-volt range.

### *Supplies*

H.T. supply, 355 V across C7.

Total feed, 130 mA.

Power consumption, 0.4 amp at 230 V a.c.

### **General Data**

#### *Impedances*

|                       |                                  |
|-----------------------|----------------------------------|
| Source                | Z = 600 $\Omega$                 |
| Input                 | Z = 2,000 $\Omega$ at 1,000 c/s. |
| Output to loudspeaker | Z = 1.2 $\Omega$ " " "           |
| Output to test-jack   | Z = 135 $\Omega$ " " "           |
| Normal load           | L.S. speech-coil                 |

### **Test Data**

#### *600-ohm Test Gain*

Measured at *Mon. Amp. Out* (500  $\Omega$ ) test-jack:

Gain-control at maximum.

Tone source sending level at -60 db.

Gain at 1,000 c/s, G = 84 db.

#### *Frequency Response*

50-10,000 c/s:  $\pm 1.5$  db relative to 1,000 c/s.

### **Monitor Amplifier 89AA (Fig. 7)**

This amplifier is used with Presto recording equipment Type 8N. It is similar to the 89A, except that cathode-current metering circuits are provided, and different transformer types are employed.

### **Valve Data**

| Valve                           | Anode<br>Volts | Screen<br>Volts | Cathode<br>Volts | Cathode<br>Current<br>mA | Fil.<br>Volts | Fil.<br>Amps |
|---------------------------------|----------------|-----------------|------------------|--------------------------|---------------|--------------|
| Stage 1<br>2 6SJ7's or<br>6J7's | 75             | 29              | 1.8              | 0.75                     | 6.3           | 0.3          |
| Stage 2<br>2 6SJ7's             | 55             | 29              | 2.0              | 0.75                     | 6.3           | 0.3          |
| Stage 3<br>2 6L6's or<br>1622's | 345            | 250             | 20               | 6.2                      | 6.3           | 0.9          |
| Rectifier<br>5Z3                |                |                 | 375              |                          | 5.0           | 3.0          |

*Note:* Measured with Avometer Model 40. Cathode voltages stages 1 and 2 on 120-volt d.c. range, other voltages on 1,200-volt d.c. range. Cathode currents measured via feed-meter jack on 12-mA d.c. range.



## INSTRUCTION R4

### Section C

#### Phase-splitter

The circuits associated with the double diode V3 are so arranged that the output voltages from the two anodes are 180° degrees out of phase. Fig. C.3 shows the two sections of V3 re-drawn as separate valves. The anode of the driving valve V3A is connected to the grid of the phase-inverter V3B through C5, R10, the values of C5, R10, R12 being chosen to make the voltages applied to the two sides of the output stage equal in magnitude but opposite in phase.

The two valve sections V3A and V3B have common cathode bias provided by R14, C8, but the cathode circuit of V3A also includes the feedback winding of the recording head. The effects of this winding are explained in Instruction R2, Section B.

#### Output Circuits

On the secondary side of the output transformer TR 2 there are two windings, as shown in Fig. 8. The 250-ohmappings on the 500-ohm winding are connected to the output meter, and the 15-ohm winding is connected to the recording-head main winding. The meter is adjusted to read zero at 1,000 c/s when the voltage level across meter and series resistance is +25 db, this corresponding to a voltage level of +11 db across the recording head. (When the Type-B recording heads were first installed, their mean sensitivity when recording zero level was taken as +11 db, and the recording-head meters were adjusted to read zero with this level on the heads. However, the majority of heads are about 1 db less sensitive than this, and a sensitivity of +12 db, as assumed in the instruction on the Type-D recorder, is probably a more representative figure.)

Fig. C.4 shows the frequency response of the

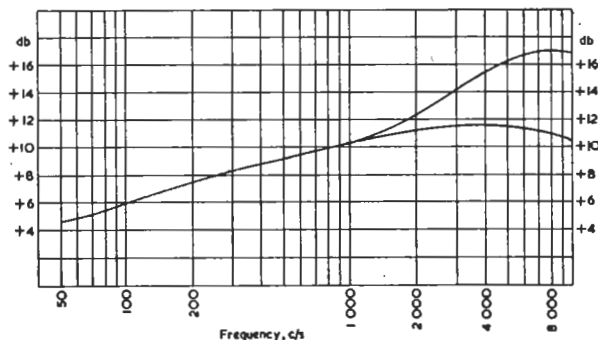


Fig. C.4. 88AB Amplifier: Frequency Characteristic

amplifier measured across the recording-head main winding with the main and feedback windings

connected normally. The figure indicates the maximum and minimum high-frequency response at the two extreme settings of R40. The method of obtaining the correct setting for any individual recording head is explained in connection with the frequency-response tests described in Section G.

#### Valve Data

| Valve             | Anode Volts | Anode Current mA | Screen Volts | Screen Current mA | Fil. Volts | Fil. Amps |
|-------------------|-------------|------------------|--------------|-------------------|------------|-----------|
| Stage 1 6SF5      | 45          | 0.15             |              |                   | 6.3        | 0.3       |
| Stage 2 6J7       | 90          | 1.0              |              |                   | 6.3        | 0.3       |
| Stage 3 6F8G      |             |                  |              |                   |            |           |
| Driver            | 120         | 2.7              |              |                   | 6.3        | 0.3       |
| Inverter          | 120         | 2.7              |              |                   |            |           |
| Stage 4 4 807's   | 440         | 50               | 320          | 1.5               | 6.3        | 0.9       |
| Rectifiers 2 83's |             |                  |              |                   | 5.0        | 3.0       |

Note: Anode and screen volts measured with Universal Avomitor, on 500-volt range.

#### Supplies

H.T. supply, 460 V between h.t. fuse and earth.

Total feed, 210 mA.

Power consumption, 0.9 amp at 230 V.

#### General Data

##### Impedances

|                                  |                                                                                         |
|----------------------------------|-----------------------------------------------------------------------------------------|
| Source                           | $Z = 600 \Omega$                                                                        |
| Input                            | $Z = 600 \Omega$ at 1,000 c/s                                                           |
| Output (250 $\Omega$ ) to meter  | $Z = 31 \Omega$ at 1,000 c/s                                                            |
| Normal load (15 $\Omega$ output) | Recording head Type B/1A main winding ( $R = 3.7 \Omega$ , $L = 1.65$ mH at 1,000 c/s.) |

#### Test Data

##### 600-ohm Test Gain

Test conditions:

Gain control set at maximum.

Tone source sending level at -60 db.

Gain at 1,000 c/s across 250  $\Omega$  output,  $G = 69$  db.

##### Normal Output Level

See text.

##### Noise Level

-53 db.

##### Frequency Response

As in Fig. C.4.

## INSTRUCTION R4

### Section C

#### Recording Amplifier 88AC (Fig. 9)

This amplifier is used with Presto Type-8N equipment. As can be seen from the circuit diagram, Fig. 9, it is basically similar to the 88AB. The principal changes are that V2 is a triode instead of a triode-connected pentode, and that feed-metering circuits are provided.

#### Valve Data

| Valve                | Anode<br>Volts | Screen<br>Volts | Cathode<br>Volts | Cathode<br>Current<br>mA | Fil.<br>Volts | Fil.<br>Amps |
|----------------------|----------------|-----------------|------------------|--------------------------|---------------|--------------|
| Stage 1<br>6SF5      | 40             |                 | 1                | 0.2                      | 6.3           | 0.3          |
| Stage 2<br>6J5       | 85             |                 | 4                | 0.9                      | 6.3           | 0.3          |
| Stage 3<br>6F8G      |                |                 |                  |                          |               |              |
| Driver               | 120            |                 |                  | 2.7                      | 6.3           | 0.3          |
| Invertor             | 120            |                 |                  | 2.7                      |               |              |
| Stage 4<br>4 807's   | 440            | 320             | 24               | 6.0                      | 6.3           | 0.9          |
| Rectifiers<br>2 83's |                |                 | 460              |                          | 5.0           | 3.0          |

*Note:* Measurements taken on Avometer Model 40; voltages on 1,200-volt d.c. range, except cathode voltage which was taken on 120-volt d.c. range. Cathode currents measured via feed-meter jack on 12-mA d.c. range.

#### Supplies

H.T. supply, 450 V between H.T. fuse and earth.

Total feed, 210 mA approx.

Power consumption, 0.9 amp at 230 V.

#### Other Data

As for recording amplifier 88AB.

#### Switch-and-fuse Panel

This panel is situated at the bottom of the amplifier bay, either on the front or at the rear. It carries a master mains switch and a pair of 5-amp fuses, a pilot-lamp being connected across the apparatus side of the switch.

On Type-6N equipments the mains supply for the turntable motors is also connected via this switch, and an additional pair of fuses is provided on the panel.

On Type-8N equipments, mains isolating switches are provided on the recording machines themselves, the machine mains supplies being taken either from wall sockets or from a separate connector-panel in the base of the rear part of the bay.

## SECTION D

## THE PROGRAMME CHAIN

**General**

The programme chain may conveniently be divided into two parts:

- (i) The recording chain,
- (ii) Comprehensive-checking circuits.

**The Recording Chain (Figs. 10 and 11)**

The arrangement now regarded as standard is that involving the use of a line-up key as employed in channels Type JB (Fig. 10) and Type JC (Fig. 11). This standard arrangement will be considered first, the recording chain in channels not fitted with a line-up key being described later.

the comprehensive checking circuit. The limiter input attenuator is followed under normal conditions by pads 1 and 2, which introduce a total loss of 21 db at the input to the limiter amplifier. The limiter output is connected via TR13, and thence, normally, through contacts on relay LU2 direct to the recorder input switch.

When the line-up key is operated to the *Line-up* position, the programme input jack is disconnected, and the input to TR11 is taken from the 900-c/s tone source. Relays LU1 and LU2 are energised through additional contacts on the key, LU1 removing pad 1 from circuit, and LU2 inserting

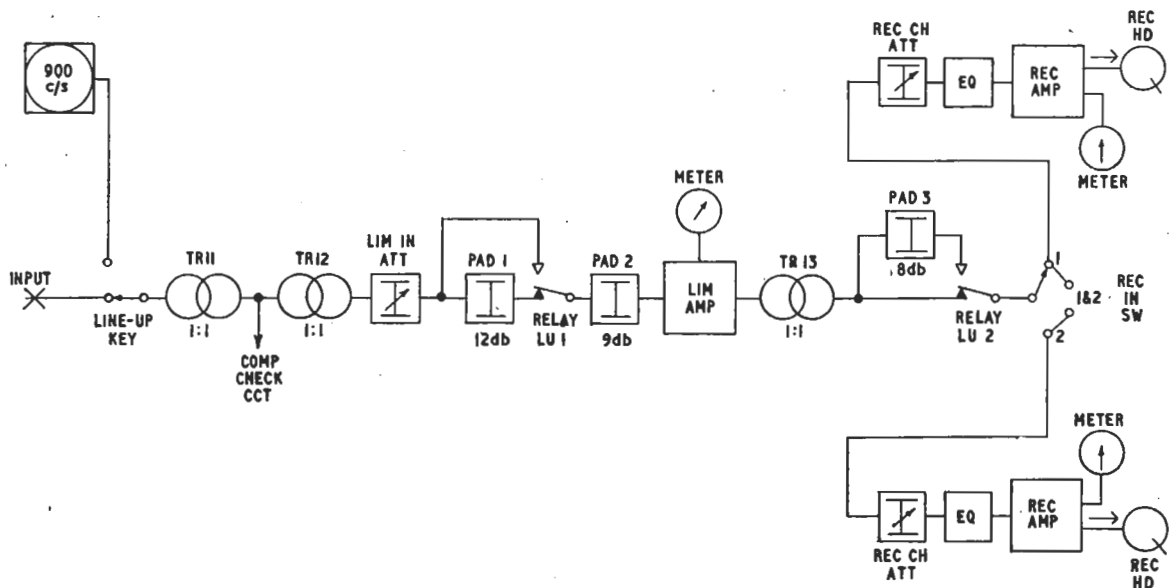


Fig. D.1. Simplified Recording Chain: Channels Type JB and JC

A block schematic of the standard recording chain is given in Fig. D.1. The programme input jack and a source of zero-level 900-c/s tone are wired via the two-position line-up key to repeating-coil TR11. The purpose of this repeating-coil is to eliminate cross-talk on the incoming line by providing a balanced input. The input impedance to the chain is 600 ohms.

In the normal or *Record* position of the line-up key the programme input jack is connected through to TR11, the secondary side of TR11 being connected to the limiter input attenuator via TR12, and to

pad 3. The removal of pad 1 reduces the loss introduced between the limiter input attenuator and the limiter amplifier from 21 db to 9 db, while pad 3 introduces an 8-db loss between the limiter output and the recorder input switch. The functions of the loss-pads are explained later.

At the recorder input switch the chain divides, each of the two branches containing one of the recording amplifiers and recording heads, either or both of which can be brought into circuit by means of the switch.

Each recording amplifier is preceded by a re-

## INSTRUCTION R4

### Section D

cording-chain attenuator and a radius-compensation equaliser. The recording-chain attenuator is normally set for minimum attenuation, and in conjunction with a matching network on its input side then introduces a loss of approximately 11 db. Referring to either Fig. 10 or Fig. 11, the recorder input switch, SW 1, is connected to the side of the recording-chain attenuator marked *Out* through a 500-ohm resistor, R24. The side of the attenuator marked *In* is connected through a further 500-ohm resistor, R22, to the radius-compensation equaliser which has 2,000 ohms across its input. With this arrangement each attenuator has at all settings an input impedance of approximately 900 ohms, and both attenuators in parallel therefore present 450 ohms to TR13; due, however, to copper losses in the transformer, the load seen by the limiter is 550 ohms.

To avoid changes in recording level it is necessary to keep the limiter load impedance constant for all positions of the recorder input switch. For this reason, when only one machine is in use, a 900-ohm resistor is connected in place of the other machine by means of the switch.

### Radius-compensation Equaliser

#### General

The unit is divided into two sections: (i) a tuned rejector circuit (Fig. 10) mounted on the equaliser panel, and (ii) a variable attenuator and variable resistance network (Fig. 12) attached to the traversing assembly of the recording machine. A fixed attenuator is also provided; this takes the place of the equaliser when the equaliser switch is in the *Off* position. The purpose of the unit as a whole is to increase the recording-amplifier input voltage at the upper frequencies progressively as the recording head moves toward the centre of the disk.

The need for this increase is as follows. As the linear groove-speed is reduced, there is a decrease in the efficiency of the recording head, due to an increasing load opposing the lateral movement of the cutter. The decrease in efficiency is more marked at the upper frequencies than at the lower frequencies, because near resonance the internal mechanical impedance of the head falls off rapidly, thus allowing the cutting load to predominate. (Further information on this subject is given in Instruction R2 and in the Recording Training Manual.)

Another source of high-frequency loss occurs on reproduction. As the reproducing stylus approaches the centre of the disk, and the linear groove speed falls, there is a reduction in wavelength for a given

frequency. At the higher frequencies, the stylus tip has increasing difficulty in following the indentations of the groove, with a resulting loss in output. The magnitude of this tracing loss depends partly on the design of the reproducing head, and complete compensation is usually impossible.

#### Circuit Description

Referring to the simplified circuit, Fig. D.2, the capacitor C1 across R22 provides a general top-lift at  $33\frac{1}{3}$  r.p.m.; this is necessary because the linear speed at the outside of a  $17\frac{1}{4}$ -inch disk at  $33\frac{1}{3}$  r.p.m. is less than that at the outside of a 12-inch disk at 78 r.p.m. At 78 r.p.m., with C1 out of circuit, the presence of R22 introduces a 1,000-c/s loss of 6 db.

To the right of C1, R22, is the radius compensator proper. This has a 1,000-c/s insertion loss of 31 db; in the *Off* position of the equaliser switch the equaliser is replaced by a 31-db attenuator (Fig. 10).

The compensator is essentially a parallel-resonant L-C circuit which is shunted across the input of the recording amplifier. The circuit has maximum impedance, and therefore minimum shunting effect, at its frequency of resonance; this, for 78-r.p.m. recording, is approximately 10,000 c/s, and for  $33\frac{1}{3}$ -r.p.m. recording, approximately 6,000 c/s. It follows that at these frequencies the input voltage to the recording amplifier is at a maximum.

As the diameter of recording changes, the value of this maximum voltage and its relationship to the voltage at other frequencies is altered by the action of the equaliser and attenuator sliders.

The equaliser slider controls a resistance which is large compared with that of the tuned circuit at resonance, and is in series with the tuned circuit across the recording amplifier input. At the outer recording diameter, the whole of this series resistance is in circuit, and because its impedance is high compared with that of the amplifier, the attenuation introduced is negligible at all frequencies. At the inner recording diameter, the shunting effect of the tuned circuit is fully realised, and considerable attenuation occurs at frequencies remote from resonance.

Since it is required to accentuate the higher frequencies rather than to attenuate the lower ones, an additional slider is used to control a variable attenuator, which is separated from the resonant circuit by a fixed T-network. The attenuator slider introduces maximum loss at the outer diameter where the effect of the tuned circuit is a minimum. At the inner diameter this loss is reduced in order to maintain constant level at 1,000 c/s in spite of the

effect of the tuned circuit. The fixed T-network is provided in order to preserve a reasonably constant impedance at the radius compensator input.

Frequency characteristics showing the effect of radius compensation both at 78 r.p.m. and at 33 $\frac{1}{3}$  r.p.m. for various recording diameters are given in Section D of Instruction R2.

### Levels in the Recording Chain

#### *Prefatory Note*

The following account is simplified by omitting to consider losses in the various transformers, amounting to one to two db in each. The limiting level and the effects of other components are also slightly variable.

programme source is replaced by a zero-level 900-c/s oscillator. By definition, programme at zero volume has the same peak voltage as tone at a level of +8 db and it therefore follows that, for limiting to occur, the attenuation in the chain prior to the limiter input must be 8 db less where the zero-level tone source is used than with a zero-volume programme source. In order to ensure definite limiting action, however, it is standard practice when lining up on tone to reduce the input attenuation by 12 db, thus obtaining 4 db of limitation. The change in attenuation is obtained either by shorting out a 12-db loss-pad (pad 1 in Fig. D.3b) by means of a relay controlled by the line-up key, or by altering the setting of the limiter input attenuator.

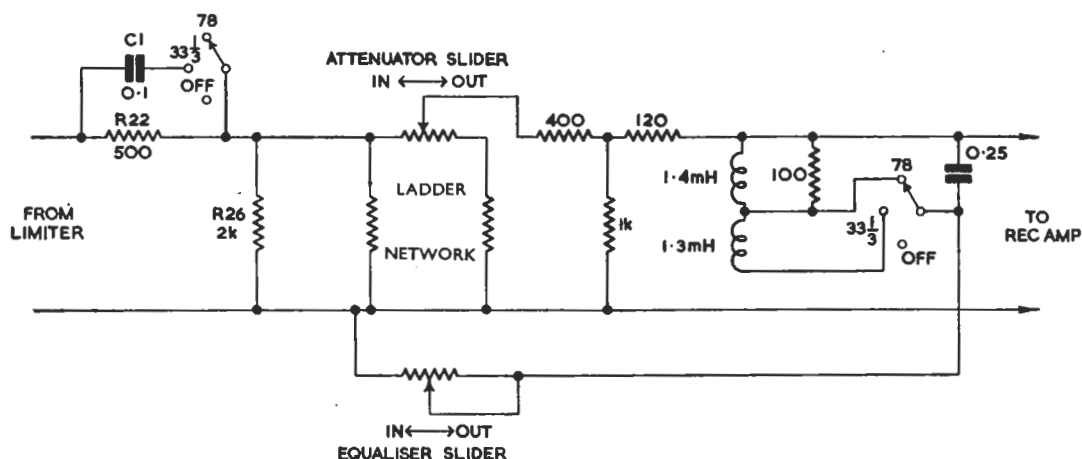


Fig. D.2. Radius Compensator: Simplified Circuit

#### *Adjustment of Recording Level*

In order that the desired recording level may be obtained, the limiter input attenuator must be set so that incoming programme at zero volume is just limited on occasional peaks, and the gain-control of each recording amplifier must be adjusted so that these peaks are recorded at 8 db above the peak level of the 1,000-c/s tone on test record DOM 25. (As the standard reference tone on DOM 25 is recorded at an r.m.s. velocity of 2 cm/sec, giving a peak velocity of  $2\sqrt{2}$  cm/sec, it follows that on programme the maximum peak velocity at 1,000 c/s, ignoring radius compensation, should be 8 db above this, i.e., 7.07 cm/sec.)

Since accurate measurements are possible only on steady tone, for line-up purposes the zero-volume

Under limiting conditions, the peak voltage at the limiter output is the same as that of tone at +16 db, and during lining-up operations tone at this level therefore appears at the output of the limiter. Since, however, the recording level is adjusted by reference to test record DOM 25, the peak level on which is 8 db below the peak-programme recording level, an 8 db pad is placed after the limiter in order to obtain the required test input level to the recording amplifiers. The 8-db pad may either be controlled by a relay operated by the line-up key (cf. pad 3 in Fig. D.3a) or else take the form of a plug-in attenuator.

Under the conditions now obtained, a test recording is made on each machine. This is reproduced and its level compared with that of DOM 25, any

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discrepancy being then compensated for by adjustment of the recording-amplifier gain-controls. Finally, in preparation for the recording of pro-

#### Channels with 8-db Plug-in Attenuator

On the earlier war-time installations (channels Type AB and ALB) a line-up key and line-up panel

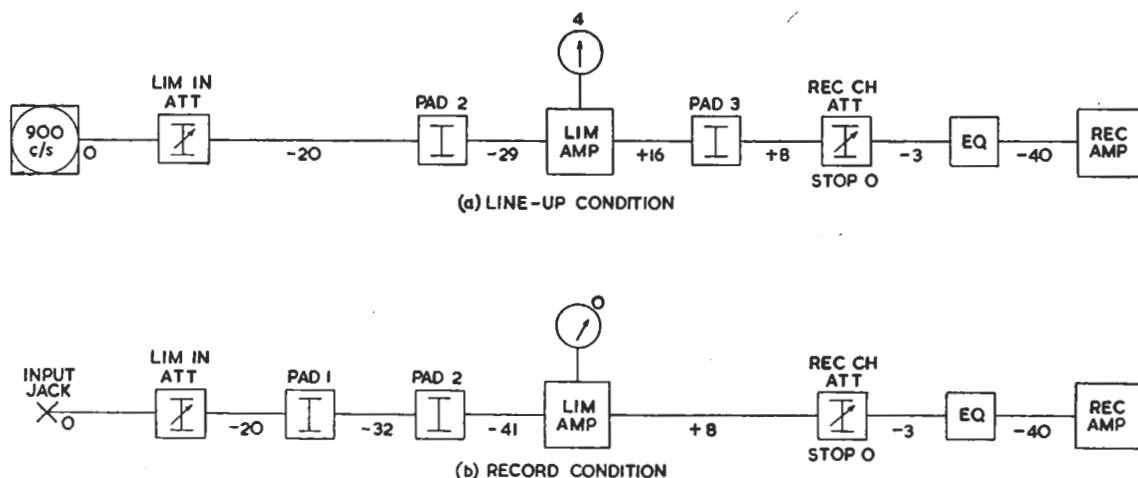


Fig. D.3. Channels with Line-up Panel and Key

gramme, the channel input circuits are restored to normal and the 8-db pad at the limiter output is removed.

#### Channels with Line-up Key

These channels include a line-up panel, LUP/1, mounted inside the bay cabinet. The panel carries three fixed-loss pads, the first and third of which are controlled by two relays operated by the line-up key on the control panel. The circuit is shown in Figs. 11 and 12 and also, in simplified form, in Fig. D.1.

When the line-up key is in the operated position, the local zero-level tone-source is connected to the limiter input attenuator, and relays LU 1 and LU 2 are energised. Relay LU 1 removes a dummy 600-ohm load from the tone-source and connects the limiter input attenuator to pad 2, while relay LU 2 inserts pad 3 between the limiter output and the radius compensator equaliser.

It is standard practice during line-up to adjust the limiter input attenuator to produce 4 db of limitation as indicated on the limiter meter. The levels are then approximately as shown in Fig. D.3a.

When the line-up key is returned to the normal position, the channel input jack is connected to the limiter input attenuator, and pad 1 is inserted in the chain while pad 3 is removed. The resulting arrangement is shown in Fig. D.3b.

are not provided, and when lining up the channel an 8-db plug-in attenuator is inserted after the limiter. This corresponds to pad 3. Pads 1 and 2 are replaced by a fixed 21-db loss-pad permanently wired in the limiter input circuit, and line-up level is obtained by fading up the limiter input attenuator 12 db above its normal setting, this operation corresponding to the removal of pad 1.

The levels at the various points in the chain for (a) the *Line-up* condition and (b) the *Record* condition are shown in Fig. D.4.

#### Channel-linking System (Fig. 13)

##### General Description

At centres where two or more Presto channels are installed, a channel-linking system is provided, the function of which is to centralise change-overs in one channel when two or more channels are recording the same programme. A simplified diagram of the system is given in Fig. 13.

The basic principle of the channel-linking system is that of a *Master* channel linked to one or more *Slave* channels for the purpose of multiple recording. The switching of the programme from one machine to another is effected simultaneously in all channels by the operation of the *Recorder Input* switch in the master channel, the corresponding switch in the slave channel being put out of action, and its function replaced by change-over relays (CL 1 and CL 2,

Fig. 13). The system is versatile, any one channel being capable of operating as a master or slave, the wiring in all channels being identical.

additional section of the *Recorder Input* switch is brought into use and connects the 24-volt supply to the slave channel circuits as required.

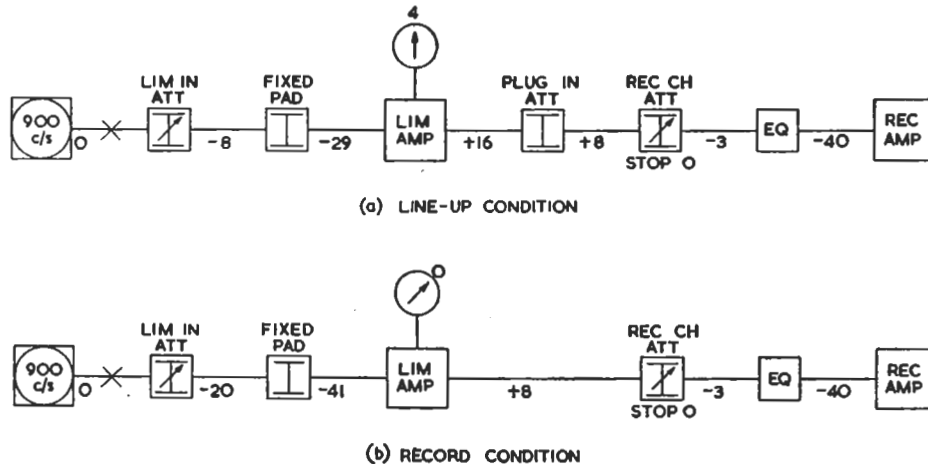


Fig. D.4. Channels with 8-db Plug-in Attenuator

The amplifier bay in each channel is fitted with a 3-position *Channel-linking* key, the positions being designated *Master*, *Solo* and *Slave*. Two relays are also fitted to the bay; these operate only when the channel-linking key is in the slave position. Their function is to switch the programme from one machine to another in the slave channel, the 24-volt negative line to the relay windings being controlled by the *Recorder Input* switch of the master channel.

The actual linking between the channels is effected by permanently connecting together the corresponding travellers of the linking keys in the several channels.

The conditions obtaining for each position of the channel-linking key are shown in Fig. 13.

#### *Solo Position*

For normal single-channel working the channel-linking key is kept in the *Solo* position. In this position of the key the channel is isolated from other channels and is operated under normal conditions, except that the programme path between the *Recorder Input* switch and the recording amplifiers is completed via the break contacts of the relays.

#### *Master Position*

In this position of the channel-linking key the change-over circuit in the master channel itself is similar to that obtaining for the solo position. An

#### *Slave Position*

In this position of the key the 24-volt circuit from the master channel is completed to the coils of the relays and positions 1 and 3 of the centre section of the *Recorder Input* switch are shorted, so that it is not possible to break the programme circuit to either recording amplifier by the manipulation of the switch. Further, the 900-ohm shunt resistor is removed from circuit, and is replaced by the 900-ohm resistor brought into use by the operation of the relays. When the *Recorder Input* switch in the master channel is set to *Position 1*, the 24-volt supply is connected to relay CL 2 in the slave channel, thus breaking the programme circuit to recording amplifier No. 2, and replacing its input impedance by the 900-ohm loading resistor.

When the master channel switch is set to *Position 3*, the 24-volt supply is connected to relay CL 1 in the slave channel, thus breaking the programme circuit to recording amplifier No. 1, and replacing its input impedance by the 900-ohm loading resistor.

When the master channel switch is in *Position 2*, none of the slave channel relays are energised, so that programme is applied to all recording amplifiers.

#### **Comprehensive-checking Circuits**

##### *Type-8N Equipment*

The comprehensive-checking circuit of the Type-8N equipment is shown in Fig. D.5.

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By means of the *Monitor Input* switch, the loud-speaker can be connected to the output from either reproducing head, or to the incoming line. Each reproducing head is connected to the switch through a separate transformer-attenuator, TA/2A. This unit, described in Instruction R5, Section A, is mounted behind the machine connector-panel, and provides high-frequency equalisation for the head.

G/9 equaliser unit. On the Type-6N equipment as originally installed there is no provision for balancing the outputs of the two reproducing heads, but on the modified equipment separate head attenuators are provided.

#### Equaliser G/9

The G/9 unit, shown in Fig. D.6, has an input

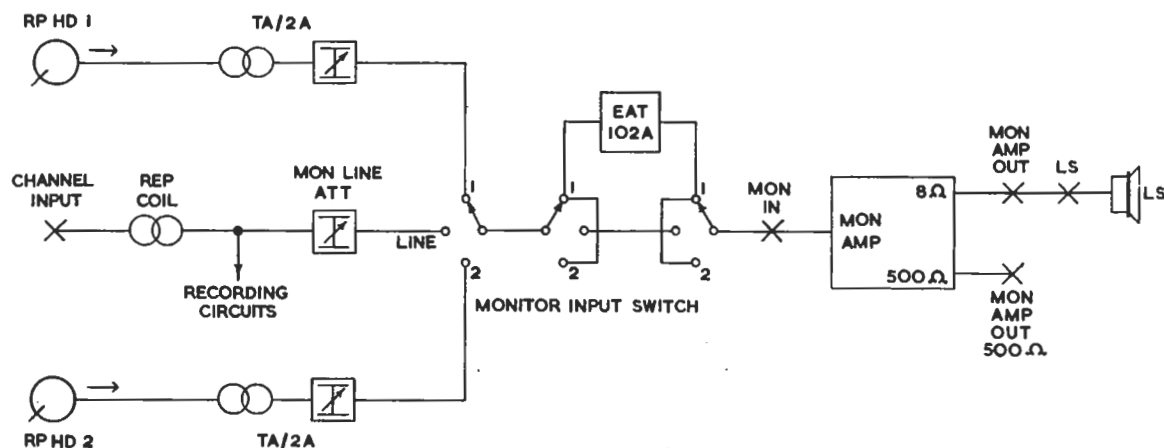


Fig. D.5. Comprehensive-checking Circuit: Type-8N Equipment

The attenuator section of the unit permits balancing of the outputs from heads of differing sensitivities. The level of incoming programme with respect to that from the reproducing heads is controlled by the pre-set *Monitor Line* attenuator.

Additional contacts on the *Monitor Input* switch insert an equaliser-attenuator EAT/102A in the circuit when either reproducing head is selected. The EAT/102A is shown in Fig. 2 of Instruction R5, and incorporates a bass-equaliser EQ/102S, details of which are given in Section A of the above instruction.

The switch is connected to the monitor amplifier, which has two outputs; the low-impedance output is connected to the loudspeaker, while the high-impedance output is terminated on a test-jack labelled *Mon. Amp. Out 500Ω*.

#### Type-6N Equipment

The general arrangement of the comprehensive-checking circuit is similar to that on Type-8N equipment, but in Type-6N channels the equaliser-attenuator and transformer-attenuators are not fitted, all the correction being provided by a single

transformer which loads the reproducing head with approximately 50 ohms at all frequencies, and at the same time steps up its output voltage by some 10 db. With a 50-ohm load the head has an output

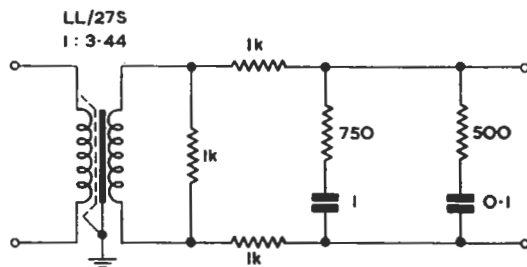


Fig. D.6. Reproducing-head Equaliser: Type G/9

which, except near resonances, is proportional to recorded velocity. The loading condition does not, therefore, introduce any frequency correction.

On the secondary side of the transformer a load impedance, of the order of 700 ohms, is provided by a balanced attenuator which separates the input

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circuit from the correction network. This network comprises two R-C circuits connected in parallel across the line. One circuit, containing the 1-microfarad capacitor (Fig. D.6), provides the bass correction, its discriminating properties being centred on

the range of frequencies near 500 c/s. The other circuit, containing the 0.1-microfarad capacitor, provides the top correction; this latter circuit has maximum frequency response variation in the region of 3,000 c/s.

## SECTION E

## SWARF REMOVAL EQUIPMENT TYPE SRE/1 AND SRE/2

## Introduction

The equipment employs a high air-velocity suction system which possesses considerable advantages over systems employing lower air velocities. ~~Provision is made for automatic control of the suction pump motor by means of a micro switch incorporated in the traverse head test pedestal, a second switch is provided with the test pedestal, which allows alternative manual control.~~

An important feature of the equipment is the positioning of the suction orifice in relation to the cutting stylus. The optimum position is adopted, underneath the recording head and immediately opposite the stylus cutting facet. A flat nozzle-shape is used, as this allows the requisite orifice area to be obtained in the confined space between the disk and the recording head. The nozzle removes the swarf as it is cut, without allowing it to return to the disk surface where electrostatic attraction might cause it to stick to the groove. By this means the need for using anti-static solution is eliminated, and most of the causes of swarf pile-ups are removed. Due to the high nozzle air-velocity silencing is necessary and is applied in a simple manner.

Each recording machine is provided with a separate complete equipment, comprising the following units:

- (a) Nozzle, and nozzle-mounting unit,
- (b) Swarf container assembly,
- (c) Pump and filter/silencer unit,
- (d) Automatic pump-switching traverse-head pedestal.

The SRE/1 is designed for use with Presto Type-6N recorders and the SRE/2 for use with Presto Type-8N recorders. The two equipments are similar but have a different arrangement of nozzle unit, necessitated by the difference in the methods of mounting the recording head on the 6N and 8N machines.

Design Considerations<sup>1, 2</sup>*The Suction Nozzle and Air Flow*

Where suction is not applied, the normal uncontrolled path of the swarf is as shown in Fig. E.1. The swarf, in these circumstances, may cause noise by striking the cutter in passing, and is also liable to

pile up round the cutter. The only really effective cure for these difficulties is the use of a suction system.

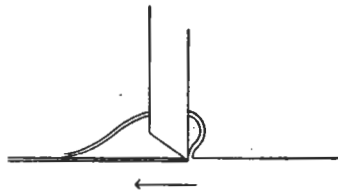


Fig. E.1. Normal Uncontrolled Swarf Path, without Suction Nozzle

When considering a new design of suction equipment, experiments were made to determine the best position for the suction orifice in relation to the cutter by installing nozzles at various angles about the cutter axis. Minimum background noise, freedom from cutter squeak, and positive pick-up of the swarf were achieved when the suction orifice was on the leading side of the cutter, immediately opposite the cutting facet, as illustrated in Fig. E.2; this nozzle position was therefore adopted.

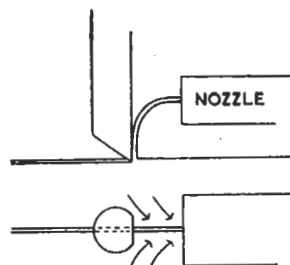


Fig. E.2. Optimum Position for Suction Nozzle

It was thought desirable that the system should, if possible, work efficiently without any form of antistatic treatment, and with the present equipment this result has been achieved.

Since the charged swarf is attracted by the oppositely charged disk, to prevent contact between them the suction orifice must be placed in close proximity to both the cutter and the disk surface. If the swarf is allowed to return to the disk before

1. Designs Department Report No. 1.5 (49).
2. H. G. Stoneham. 'Swarf Removal for Direct Disk Recording.' *BBC Quarterly*. 6 (Spring 1951) 55-61.

entering the nozzle, it tends to stick to the groove, as shown in Fig. E.3. The resulting swarf-tension variations are transmitted back to the cutter, producing audible clicks, and the swarf also becomes more difficult to collect.

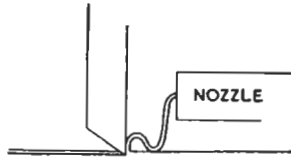


Fig. E.3. Effect of High Electrostatic Charge on Swarf Path

If, therefore, the charged swarf is to be removed effectively, on leaving the cutting point it must be drawn straight into the nozzle by the surrounding air-stream. The force exerted on the swarf is directly related to the velocity of the air flowing past it, and this force must be great enough to overcome the electrostatic forces of attraction. The volume of air flowing in unit time need only be sufficient to enclose the swarf in a moving column of air. A small flow at high velocity is most efficient, and a very high nozzle air-velocity, of the order of 700 ft/sec, is necessary for this reason. A high air-velocity is also necessary within the tube between the nozzle and the swarf container in order to keep the swarf airborne during transit, the force acting on the swarf being greatest where the air-velocity is highest, in the centre of the tube. To minimise frictional losses a smooth-bore tube is required, and to ensure freedom from air turbulence bore mis-matches must be avoided.

#### Nozzle-noise Reduction

To reduce the considerable nozzle noise which resulted from using a high air-velocity, experiments were made to miniaturise a 'straight through' absorption-type silencer, as used for internal combustion engine exhausts. This, when incorporated within the nozzle, provided effective noise reduction. The amount of absorbent material was restricted by the space available, the flat section of the nozzle permitting the material only in each corner. Various types of absorbent material were tried, commercial wool being the final selection.

#### Suction Pump Requirements

The suction pump is required to produce a high air-velocity and hence must have a high operating depression. The working condition must be attained

within four to five seconds of starting up, and the pump must function for long periods without attention. An eccentric-vane pump is the quietest and least expensive type fulfilling these requirements, and its use has therefore been adopted. With the selected vane pump, the most efficient operating conditions are obtained with a nozzle area of 0.008 square inches, and a working depression of approximately 9 inches mercury gauge.

#### General Description

##### *Suction-tube and Nozzle (Figs. 14 and 15)*

These are constructed from quarter-inch diameter aluminium tube, the bore of which is highly polished in order to reduce air friction. The tube for the SRE/1 (Fig. 14) and that for the SRE/2 (Fig. 15) are of different lengths, and are each shaped to fit the appropriate type of recording machine. The nozzle at the end of the tube is flattened to allow it to pass under the recording head. The horizontal distance between the suction orifice and the cutter is pre-set by a saddle-clamp which locks the tube in position, but the vertical distance from the disk surface is made adjustable. This is necessary because it is not practicable to attach the nozzle to the recording head itself, and provision must therefore be made for variation in the length of the cutter and in the thickness and flatness of the disk.

##### *Nozzle-mounting and Recording-head Swivel Unit for SRE/1*

The nozzle-mounting unit for swarf removal equipment SRE/1 is shown in Fig. 14. This unit is intended for use with a Type-8N recorder, and in Fig. 17 it is shown mounted in position. The unit is attached to the moving part of the existing vertical slide, and replaces the pivot-block about which the recording head is normally pivoted.

The unit comprises a slide-block with a rigidly attached bridge and with lateral projections drilled to receive the recording-head pivots. A dovetail slide moves vertically in the slide-block, and carries with it the suction nozzle. Connecting the slide-block bridge and the slide itself is a knurled-headed screw, by means of which the height of the nozzle above the disk may be adjusted.

##### *Nozzle-mounting Unit for SRE/2*

The nozzle-mounting unit for swarf removal equipment SRE/2 is shown in Fig. 15. This unit is for use with a Type-6N recorder. It is attached to the recording-head carriage and provides for vertical adjustment of the position of the suction nozzle.

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The knurled adjusting screw, instead of being in the centre of the bridge, is on one side. With the SRE/2 the original pivots of the recording-head bracket are not disturbed.

#### *Nozzle Silencing Elements*

These consist of two similar strands of ordinary three-ply knitting wool, each  $2\frac{1}{2}$  inches long. The strands are attached to the nozzle saddle-clamp and are initially drawn into each corner of the flattened nozzle by the air stream.

#### *Swarf Container Assembly (Fig. 16)*

This assembly, shown in Fig. 16, is mounted on the back of the recording-machine pedestal. On 8N recorders it is fastened to the detachable cover of the machine connector panel; on modified 6N recorders, which have a smaller connector panel, the assembly is fastened to the pedestal itself, adjacent to the panel cover.

The swarf container is a glass bell-jar designed to withstand the pressure of the atmosphere under all operating conditions with an adequate margin of safety. Surrounding the jar is a metal guard in which inspection slots are provided to enable the operator to see the level of the swarf. The container lid is freely pivoted, and under operating conditions provides an airtight seal due to the external pressure of the atmosphere. The air outlet from the swarf container is through a 120-mesh brass gauze swarf-screen to a large-bore flexible hose connecting the pump inlet and the bell-jar by easily detachable screwed unions.

#### *Pump and Filter/Silencer Unit (Fig. 18)*

The suction pump is of the oil-immersed eccentric-vane type, with a speed of 700 r.p.m. It is mounted

on a common bed-plate with a single-phase induction motor rotating at 1,425 r.p.m., the drive, with the necessary speed reduction, being by two pulleys and a V-belt. Between the pump and the motor is the exhaust filter/silencer; this has a filtered oil-drain hole in the base, and is connected to the pump exhaust by a rigid brass pipe.

The complete assembly is slung in tension from a suspension-frame on four anti-vibration springs, and the unit is housed in the lower front section of the machine pedestal cabinet. The cabinet walls are covered on the inside with a sound-absorbing material, and a detachable front cover with locks is provided to facilitate inspection and maintenance.

#### *Automatic Pump-switching Traverse-head Pedestal*

Automatic control of the pump motor is provided by incorporating a heavy-duty micro-switch within a new traverse-mechanism rest pedestal, while a second switch, in series with the micro-switch, provides separate manual control. When the traverse mechanism is on the rest the pump motor is switched off, but when the traverse mechanism is removed from the pedestal in order to set up for recording, provided that the hand-operated switch is closed, the motor is automatically switched on and the normal degree of suction is reached within four to five seconds.

#### *Pump Motor Wiring*

The existing 5-amp isolating switch in the rear compartment of the cabinet is used as the supply point to a 3-pin 5-amp socket for the suction-pump motor. The neutral side of the isolator is wired directly to the 3-pin socket, and the line side is wired to the socket via a terminal block and the two switches.

tag on the turntable-motor transformer  
to the pump motor switch on the  
side of the cabinet.

## SECTION F

## OPERATING INSTRUCTIONS

**1. Switching on Supplies**

To apply power to the equipment, close the following switches:

- (i) The isolating switch or switches on the walls of the recording room.
- (ii) The master switch at the bottom of the amplifier bay.
- (iii) The switches on the individual amplifiers.
- (iv) The isolating switch (if fitted) adjacent to the connector panel inside the rear compartment of each machine pedestal.

**2. Lining Up the Channel***Channels fitted with Line-up Key*

To line up the channel, carry out the following operations:

- (i) Switch on the supplies as previously indicated, and allow about five minutes for the amplifiers to become stabilised.
- (ii) Fade out the limiter input control and adjust the limiter meter to zero by means of the pre-set *Adjust Zero Level* control. Set the *Recovery Time* switch on the limiter to maximum (i.e. 5 or 6).
- (iii) Set both the equaliser controls to *Off*, and place the recorder input switch in the central position. Check that the recorder faders are at stop 0, introducing minimum attenuation.
- (iv) Operate the *Line-up* key, and fade up the limiter input control until the limiter meter reads approximately 4.
- (v) Check that the recording-head meters indicate the datum voltage shown on the tablet below each meter, and if necessary adjust the gain of the recording amplifiers until the datum voltage is obtained.
- (vi) Restore the line-up key to the *Record* position.
- (vii) Plug the required programme source to the channel input jack, and set the equaliser controls to 78 or 33 $\frac{1}{3}$  in readiness for recording.

*Channels with 8-db Plug-in Attenuator*

First carry out operations (i), (ii) and (iii) above, then:

- (a) Insert the 4-pin line-up attenuator into the *Lim.*

*Out* and *Rec. Ch. In* jacks. The attenuator is symmetrical and may be inserted either way up.

- (b) Plug the local line-up tone to the channel input jack, and fade up the limiter input control until the limiter meter reads approximately 4. Now carry out operation (v) above, and then:
- (c) Fade down the limiter input control by 12 db and remove the plug-in attenuator. Finally, carry out operation (vii).

**3. Preparing the Machines for Recording**

The procedure is as follows:

- (i) Check that the recording head is in the raised position, and that a lead-screw of the required pitch is inserted in the traversing assembly.
- (ii) Place a disk on the turntable, and make sure that the sprung driving pin is correctly located in the driving hole of the disk.
- (iii) Swing the traversing assembly forward, and lower the assembly so that the boss rests on the disk with the turntable spindle engaging the hole in the centre of the boss and the driving pin engaging one of the driving holes.
- (iv) For 78-r.p.m. recording only, where suction equipment is not provided place the swarf brush in the working position on the disk.
- (v) Move the carriage so that the cutter is above the edge of the disk. Engage the lead-screw and, by means of the hand-traverse wheel, bring the recording head into the desired position over the disk.
- (vi) Insert the safety key in the appropriate hole for either 78 or 33 $\frac{1}{3}$ -r.p.m. recording. Move the speed-change lever to the desired position and lock it by lowering the handle.
- (vii) Lower the recording head, and after cutting a few grooves, lift the cutter from the disk and stop the turntable.
- (viii) Switch on the microscope lamp and examine the grooves for general appearance and depth of cut. Adjust the depth of cut if necessary. The correct groove-to-land ratio is 2:1.
- (ix) Lower the pickup and play back the test-cut to ensure that the level of surface noise is satisfactorily low.

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- (x) Repeat all the above operations for the other machine.

*Note 1.*—The test-cut is made to determine whether the machine is cutting satisfactorily, and nothing should be recorded during the test. While the test is being made on one machine, the recorder input switch should be moved to the other machine. When test-cuts on both machines have been made, the switch should be returned to the central position.

*Note 2.*—For 33 $\frac{1}{3}$ -r.p.m. recording it is desirable to make a test-cut at the inside of the disk as well as at the outside. The tendency is for the cut to be somewhat deeper at the inside than at the outside, but it should be possible to arrive at a setting which gives a satisfactory compromise at the two extremities. The limits should be regarded as 80 : 20 and 60 : 40. If it is not possible to keep within these limits, a fault in the traversing assembly is indicated and should be attended to before the recording is begun.

#### 4. Carrying Out the Recording

##### *Level Adjustment*

The setting of the limiter input control should be adjusted in relation to the level of test-tone incoming from the programme source. In general, the control should be adjusted so that with the equaliser switches in the *Off* position the datum voltage is indicated on the recording-head meters.

Where certain types of programme, consisting mainly of speech, are to be recorded from one of the domestic services, the recording level should be increased by 4 db above the line-up level on tone. Detailed instructions on this matter appear in RDSI C8, Issue 2.

Before the recording commences, a 10-second band of 1,000-c/s standard reference-frequency tone at zero level must be recorded on the first disk to be used on each machine.

Provided that lining up has been carried out correctly, a slight re-adjustment of the limiter input control should be all that is necessary on the programme test or, if there is no programme test, at the beginning of the recording. The limiter meter should be observed frequently; it should move back only occasionally, on the heaviest peaks, and for most of the time should register a reading of zero. If there is a frequent deflection, the setting of the control should be altered until the correct condition is obtained. If the general volume is consistently different from the line-up level, then the studio or control room should be informed, and requested to adjust accordingly.

##### *Monitoring*

As soon as the recording begins, the pickup should be lowered into the groove and the *Monitor Input* switch should be set to the machine in use. The switch should be left in this position until just before the change-over and should then be moved to the *Line* position. The pickup should be removed from the disk when the change-over has been made and the other pickup similarly lowered, the *Monitor Input* switch being set to the second machine.

If the pickup is observed to jump from the groove, at any diameter, it should be replaced in position and, at the end of the recording, the relevant portion of the disk should be examined under the microscope for tracking faults.

##### *Changing Over*

When the recording head on the first machine is nearing the inner diameter limit the second machine should be started, the recording head should be lowered, and the pickup should be placed on the disk. A *Bull* or *Overlap* change-over should be made according to requirements. Instructions on this matter are given in RDSI C13.

The *Monitor Input* switch should now be set to machine 2, and a lead-out scroll should be cut on the first disk by turning the hand-traverse wheel as quickly as possible. The traverse drive should then be disengaged, and the recording head lifted after completing the finishing circle.

##### *Recording via Radio-link*

When material is received via radio-link, fading is often severe, and it may be advantageous to allow heavy limiting action in order to compensate for variations in the incoming volume. A disadvantage is that under limiting conditions the volume of circuit noise is increased in relation to programme. For this reason, where cyclic fading is experienced, the limiter input control should be set so that during troughs in the fading cycle limiting just occurs. Severe limiting action then takes place only during crests in the cycle. On noisy circuits the *Recovery Time* switch should be set to 3.

#### 5. Operating Procedure in Linked Channels

##### *General Procedure*

The channels should first be lined up independently in the manner previously described. The procedure is then as follows:

- (i) Plug the required programme to the input jack in each channel.
- (ii) Set the *Channel-linking* key to *Master* in the

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**Section F**

controlling channel, and to *Slave* in the other channels.

- (iii) Where the channels are not adjoining, arrange for telephone communication for the passing of cues.
- (iv) The programme-switching operations for change-overs are effected exclusively in the master channel.

*Additional Notes*

Successful working depends upon close co-operation between the master and slave channels. Extra staff may be required to operate the channels if telephone communication is involved. The following notes are important:

- (a) All channels must record on the corresponding machine (i.e., No. 1 or No. 2) simultaneously.
- (b) Similar-sized disks must be used in all channels

and recording must begin at the same diameter in each channel to prevent any one disk running out before the master channel changes over.

- (c) On receiving the appropriate cue, each channel must immediately carry out the indicated operation, e.g. *Lower*, *Lift* or *Scroll*. It may be desirable for the slave channels to report back to the master channel that the indicated operation has been performed.
- (d) During change-overs, each channel should watch the output meters in order to ascertain exactly when the change-over occurs.
- (e) Comprehensive-checking, disk labelling and logging must be carried out independently in each channel.
- (f) The Reference number of the recording will be the same for all channels. The individual disks must be numbered as indicated in paragraph 10 of RDSI B1.

## SECTION G

## TESTING AND MAINTENANCE

## MECHANICAL TESTS AND ADJUSTMENTS

## 1. Turntable Drive Assembly

*Machine Wow and Rumble*

These troubles may often be caused by faulty adjustment of the rubber idler-wheels, or a faulty idler-wheel itself. Twisting of the traverse frame or incorrect positioning of the worm on the worm-shaft are further possible sources of wow. The former causes the centre boss to bind on the centre pin of the turntable during part of every revolution. With the latter, the vertical thrust may be removed from the ball-race beneath the upper limb of the carriage-end casting, thus allowing the centre boss to bind on the underside of the lower limb, which is not intended to be used as a bearing surface.

The usual wow test consists in recording 900-c/s tone, with the pickup lowered and the output connected to the loudspeaker. The angular displacement between recording head and pickup accentuates the wow, and increases the severity of the test.

*Checking of Idler-wheel Adjustment*

If the drive is unsatisfactory for any reason, the turntable should be removed and the idler-wheels inspected. If oil is present on the driving surfaces these will slip very easily and must be cleaned. With the turntable removed and the speed-change lever in the 78-r.p.m. position, the forward or 33 $\frac{1}{3}$ -r.p.m. idler-wheel should be pressed in an anti-clockwise direction, thus engaging the 78-r.p.m. idler-wheel with the larger-diameter section of the driving roller on the end of the motor spindle. If the drive is badly adjusted, it will be found that with quite a moderate pressure the 78-r.p.m. idler-wheel will rise on its spindle. If this is so, the motor mounting must be readjusted. The same test should be made for the 33 $\frac{1}{3}$ -r.p.m. idler-wheel by engaging the speed-change lever in the 33 $\frac{1}{3}$ -r.p.m. position and pressing the 78-r.p.m. idler-wheel in a clockwise direction.

*Motor Mounting Adjustment\**

If either of the idler-wheels rises on its spindle when pressure is applied, the motor mounting must be adjusted so as to tilt the motor spindle slightly, in the direction required to prevent this from happening. The motor is hung on a curved top by two bolts passing through rubber washers above

and below the bracket. These bolts screw the washers to the plate to which the motor is attached and have lock-nuts underneath. These lock-nuts should be slackened, care being taken that the bolts do not rotate at the same time. The bolts are slightly bent and rotation of either will cause the motor spindle to be tilted in a vertical plane. The bolts should be adjusted to align the motor driving spindle with the idler-wheels.

When the adjustment has been made, the lock-nuts should be tightened, care again being taken to see that this does not cause the bolts to rotate. A further test should be made to see whether either of the idler-wheels rises up on its spindle. If satisfactory adjustment cannot be made in this way, or if it is found that the idler-wheels do not become free from the motor spindle with the speed-change lever in the *Off* position, it will be necessary to move the mounting bracket. This is fastened down at each end by a single bolt working in a slot. By slackening these bolts the bracket may be moved so as to shift the motor forwards or backwards with respect to the idler-wheels. The adjustment consists of:

- (i) Finding the appropriate position for the motor spindle by moving this bracket.
- (ii) Finding a suitable angle of inclination in the vertical plane by rotating the suspension screws. Care should be taken to ensure that the suspension screws are not tightened up so as to compress the rubber washers to any extent, as this will cause the underside of the 33 $\frac{1}{3}$ -r.p.m. idler-wheel to foul on the step in the motor drive spindle and so set up vibration between the motor and the framework.

*Speed-change Lever Adjustment*

After making any adjustment in the motor mounting position, it will be necessary to check the position of the stop-screws and the speed-change lever. This should be arranged so that the pressure on the driving wheels is the minimum required to give a satisfactory drive without slip. If the pressure is too great it is likely to cause both rumble and wow, and also to reduce the turntable speed.

*Faulty Idler-wheels*

Faulty idler-wheels may usually be attributed to one of the following causes:

\* In a few channels, the motors are hung on 'Silentbloc' mountings, with no facilities for adjustment.

- (a) Incorrect motor adjustment causing the idler-wheel to rise on its spindle. This, in turn, will make the idler slightly conical and will produce excessive friction between idler and retaining screw.
- (b) Stopping the turntable against the motor drive, causing the motor drive to slip and wear the idler unevenly.
- (c) Switching off the supply to the motors at the mains without disengaging the speed-change lever, thus leaving two portions of the idler under pressure and causing distortion of the rubber.
- (d) Allowing grease or oil to creep or be thrown on to the rubber surface, causing the rubber to change its shape or elasticity.

#### *Turntable Speed: Tests and Adjustments*

A standardised procedure for checking the turntable speeds is given in Recording Department Standing Instruction C11, the permissible tolerance limits, both for 78 r.p.m. and for  $33\frac{1}{3}$  r.p.m., being laid down in that Instruction.

Incorrect speed is often caused by faulty adjustment of the motor spindle and the idler. Too little pressure is likely to cause excessive slip between the two, while if the pressure is too great, loss of speed will result due to distortion of the rubber at the point of contact of the motor spindle. If the speed is slow, due to slip, it should only be necessary to increase pressure between idler-wheel and motor by adjusting the appropriate stop-screw at the side of the speed-change lever. Maximum speed is generally obtained when the idler is just gripping under all conditions of load.

A further adjustment at 78 r.p.m. is provided by the idler-wheel itself. This has two driving sections, the diameters of which differ by a few thousandths of an inch, and the turntable speed will therefore vary slightly according to which way up the wheel is put on its spindle.

## **2. Traversing Assembly (Figs. 2, 3 and 4)**

### *General*

The Type-6N traversing assembly is shown in Figs. 2 and 3, and the reference numbers in the text apply to these figures. The Type-8N assembly is shown in Fig. 4. On this assembly the traverse blade and the raise-lower lever and extension arm are not adjustable. Further, the methods of adjusting the traverse-frame swivel vertical height and the recording-head rake are different for the two assem-

blies. The remainder of the instructions apply to both assemblies.

### *Traverse-frame Swivel Lateral Adjustment*

When adjusting the traversing assembly, the first operation is to check that the centre boss (36) below the traverse mechanism, fits easily over the centre pin of the turntable and square with the disk on the turntable.

If the hole in the centre boss does not fit easily without jamming, place the assembly in the recording position with a disk on the turntable, and release the hexagonal-headed bolt (44), which clamps the split bearing above the swivelling elbow joint (9). This will release the traverse-assembly frame, which should be positioned so that the driving boss is in alignment with the centre pin of the turntable and lies square with the disk when viewed in the direction of the lead-screw. The bolt through the split bearing should then be tightened.

### *Traverse-frame Swivel Vertical Height Adjustment: Type-6N Assembly*

If it is found that the centre boss does not lie flat on the disk when viewed from the front of the machine, or that the recording-head carriage supporting bar (31) is not at a uniform height above the disk, the assembly must be raised or lowered at the elbow joint end.

To obtain this adjustment, unscrew with an Allen wrench the two small grub-screws in the plated collar directly below the elbow joint. This collar acts as an adjustable stop at the top of the traversing assembly main support pillar (45). Supporting the weight of the traversing assembly by hand, unscrew the set-screw in the main plate which locks the pillar in position, raise or lower the complete assembly at the pillar end until the centre boss fits square on the disk on the turntable, and re-lock the pillar in position. Tighten the grub-screws in the plated collar, which should be in contact with the main plate boss, and which will then prevent the pillar from slipping down out of position and act as a stop should the assembly have to be removed and replaced in position.

### *Traverse-frame Swivel Vertical Height Adjustment: Type-8N Assembly*

The traverse frame swivels on a bearing ball inside the dome-shaped casting above the elbow joint. The height of the swivel is adjustable by loosening the lock-nut on the hexagonal-headed bolt on top of the dome and rotating this bolt, which

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is in contact with the bearing ball, until the required swivel height is obtained.

#### *Traverse-blade Adjustment (Type-6N Assembly only)*

The traverse-blade (13) is engaged with or disengaged from the lead-screw by turning the knurled knob (10). The blade is raised or lowered by the action of a pin protruding from the base of the knob travelling on a spiral surface on the top of the recording-head carriage; a helical spring, housed in the lower part of the recording-head carriage, biases the blade in a downward direction. When the knob is rotated as far as possible anti-clockwise, the pin comes up against a stop and the blade is in the fully lowered position. In this position it engages the recording-head carriage with the thread of the lead-screw. In order that the blade shall remain in alignment with the thread of the lead-screw, two slots have been cut in the blade. A screw in the side of knob (10) engages in a horizontal slot in the upper part of the blade and enables the knob to turn without rotating the blade. A screw in the right-hand side of the recording-head carriage engages in a vertical slot in the side of the blade and prevents the blade turning, whilst permitting vertical motion.

Thus, while the blade is lowered and raised by turning knob (10) it does not itself turn and is always in alignment with the thread on the lead-screw.

The recording-head carriage is mounted on the top slide-bar (30) of the traverse arm, whilst its weight is supported on the lower bar (31) by a small brass stud screwed in the underside of the recording-head carriage casting, the stud being locked in position by a hexagon nut. Adjustment of the amount by which this stud projects from the casting causes the carriage to rotate about the top slide-bar, thereby raising or lowering the carriage relative to the lead-screw. The stud should be adjusted so that, with the blade fully engaged with the lead-screw, there is a clearance of approximately 1/64-inch between the underside of the knurled knob (10) and the recording-head carriage.

#### *Recording-head Rake Adjustment: Type-6N Assembly*

The rake of the recording head must be adjusted so that, when the head is in the lowered position at the inner recording diameter, the cutter is between the vertical and five degrees trailing when viewed from the side of the recording head, and is vertical when viewed from the front of the recording head. The adjustment is made as follows:

Remove the recording head from its U-shaped supporting bracket (32) by loosening the securing screws in the back of the head. Check that the face of the U-shaped bracket is precisely at right-angles to the base of the main bracket and oil dash-pot supporting bar. If it is not, slacken off securing screw (33); readjust and carefully tighten the securing screw again. Replace the head on its bracket, estimate its correct position and provisionally tighten the securing screws. Check the angles between cutter and disk by using the raise-lower lever (16) to lower the cutter on to a stationary disk. The position of the recording head on its bracket should now be adjusted to give the correct angles between cutter and disk from both aspects, remembering that lowering the head on the bracket increases the angle of trail and vice versa. Finally, re-tighten the securing screws in the back of the head.

#### *Recording-head Rake Adjustment: Type-8NA Assembly*

The rake can be altered by raising or lowering the pivots of the recording-head arm. The pivots are attached to a slide-block in a vertical slide on the front of the carriage and adjustment is effected by rotating the large knurled-headed screw which may be seen at the top of Fig. 4.

Vertical alignment of the cutter at right-angles to the angle of trail is obtained by loosening the screws securing the recording head on its bracket, the adjustment being similar to that already described for the Type-6N assembly.

#### *Extension Arm and Raise-lower Lever Adjustment: (Type-6N Assembly only)*

The extension arm (15) in contact with the raise-lower lever (16) should be adjusted by loosening its two securing screws and setting the arm so that the raise-lower lever clears the arm adequately in the lowered position of the recording head and raises the head well clear of the disk in the raised position. The arm securing screws should then be tightened.

The raise-lower lever is attached to the recording-head carriage by means of a large-headed gudgeon-pin locked in position by a small set-screw. If this lever works loose and requires adjustment, the set-screw should be slackened and pressure applied to the head of the gudgeon-pin. This compresses a small leather washer between the lever and the carriage, and in this condition the set-screw should be tightened.

#### *Recording-head Pivot Adjustment*

The recording-head pivots (14), one of which is shown, are pointed steel screws slotted for adjustment and fitted with lock-nuts. As the screws pivot in the soft metal of the recording-head carriage casting, they require frequent attention due to wear. When adjustment is necessary, the lock-nuts should be loosened, and the pivots adjusted so that the recording head and its mounting are free to pivot up and down.

It is very important that the pivots should be set to have just sufficient side-play to prevent binding, as if they are too tight the cutter is unable to follow any undulations on the surface of the disk. This may result in winking of the cut and in extreme cases in uncut patches being left on the disk surface. If the pivots are too loose, however, the recording head and mounting may at low frequencies move bodily, thereby causing distortion.

#### *Oil Dash-pot Adjustment*

The plunger and oil dash-pot must be adjusted so that the plunger clears the sides of the pot in all positions without binding, and is immersed in oil, which should be within  $\frac{1}{8}$ -inch of the top. The dash-pot (17) has on its underside a threaded projection by means of which it is secured by a knurled nut (17A) to a bracket pivoting with the recording head; the hole in the bracket, through which the threaded projection passes, is slotted in order to make the position of the pot adjustable. The dash-pot plunger remains stationary in operation and is fixed to the carriage by means of a rod and set-screw.

#### *Worm Adjustment*

The worm-shaft, which has the centre boss riveted to its bottom end, passes through the lower limb of the end casting, then through the worm (39), and directly above the worm through a steel washer, end thrust ball-race and bearing washer. These latter are recessed into the upper limb of the casting and are not clearly visible in Fig. 2. The shaft then passes through the upper limb, terminating in the swarf-brush locating pin.

The weight of the traversing assembly is carried on the end-thrust bearing above the worm, but if the worm is too low or works loose on its shaft, the centre boss will tend to bind on the lower limb of the end casting and the extra load will be liable to cause wow. It is important, therefore, to check that the worm is secure on its shaft, and that the centre driving boss is at all times clear of the lower limb of the casting. The worm is adjusted as follows:

Remove the lead-screw by unscrewing knob (11) and sliding the hand-traverse shaft outwards. Remove the shaped metal cover (38) protecting the worm, by unscrewing its two securing screws and sliding the cover upwards. The worm is secured to the shaft by an Allen screw, which locates on a small flat. The worm should be positioned on the shaft so that, when the centre boss is pressed upwards, the weight of the assembly is carried on the end-thrust bearing above the worm.

#### *Traverse Ratchet Adjustment*

The worm-wheel shaft which drives the lead-screw is itself driven by a pawl and ratchet housed inside the brass boss (41) which is attached to the lead-screw side of the worm-wheel (40) by three screws (42). The ratchet is secured to the worm-wheel shaft and is engaged by the pawl, which is recessed at its pivoting end in the worm-wheel. The pawl is held in mesh with the ratchet by a small spiral spring which presses on the back of the pawl.

If the pawl, which is situated near the oil hole (43), sticks and does not drive satisfactorily, it will probably be due to the use of an unsuitably heavy grade of oil for the pawl, or to the oil having thickened. If forcing paraffin into the hole (43) does not clear the trouble satisfactorily, the worm-wheel and boss must be dismantled. This operation requires skill, and damage to the worm-wheel may result if great care is not taken.

After removing the lead-screw, the grub-screw (37) in the hand grip should be unscrewed to enable the worm-wheel and shaft to slide out of its bearing. The three screws (42) in the boss attached to the worm-wheel should be removed and the boss levered off the two locating pins which project from the worm-wheel, the ends of these being visible near the three screws. The boss should be levered off by easing a sharp tool between it and the worm-wheel. When the worm-wheel is clear, it will be seen that inside the boss a small pawl is pressed down in contact with a central ratchet by a small spring. This spring may need strengthening, but the most likely source of trouble is thick oil. This should be washed away and the pawl and ratchet re-lubricated with oil of the 3-in-1 type. Care should be taken during re-assembly to see that the boss fits square to the worm-wheel, and the three securing screws should be carefully tightened.

#### *Worm-wheel Adjustment*

The worm-wheel should be positioned to allow some slight play between worm and worm-wheel to

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prevent them from binding together. To adjust the worm-wheel, loosen the two screws holding the hand grip (29), as this grip is also the bearing for the shaft of the worm-wheel and houses a ball which acts as an end-thrust bearing for the shaft. The screw-holes in the grip are elongated, and so allow the grip to be adjusted to mesh the worm-wheel correctly with the worm, and in this position, the securing screws should be tightened. These screws must be very firmly tightened, otherwise the strain of lifting the assembly will throw the worm-wheel out of adjustment.

#### *Assembly of Lead-screw*

The lead-screw should be replaced in position between the worm-wheel and hand-traverse centres, and the hand-traverse centre should be pressed sufficiently firmly into the lead-screw, while tightening knob (11) to ensure that there is no end-play. Unduly heavy pressure should not, however, be exercised, as this may result in bowing of the lead-screw.

Care should be taken to avoid putting burrs on either the thread of the lead-screw or the conical centres engaging with the ends. If the thread becomes burred, when the tracking blade comes into contact with the burrs during recording the groove spacing will be altered. If the centres become damaged, the true axis of the thread may no longer be the same as the axis of rotation of the lead-screw, and the grooves will then be bunched together in groups, each group corresponding to one complete revolution of the lead-screw.

#### *Final Tests*

After checking the various traverse-assembly adjustments, a depth-of-cut test should be made, comparing the depth of cut obtained on the outside of the disk with that obtained on the inside. If these are obviously different, it is probably due to faulty alignment of the traverse-assembly frame, or to this frame's being twisted, and the following check should be made:

Lower the cutter near the outside of the disk, so that it is just clear of the disk. Operate the hand traverse and, as the carriage tracks across the disk, check that the cutter remains at a uniform height above the disk surface. If this is satisfactory the *Recording-head Pivot Adjustment* and *Oil Dash-pot Adjustment* etc., should be checked again. If the cutter does not remain at a uniform height the traverse assembly must be levelled again at the elbow joint. If the trouble cannot be eliminated by

this means, it is probable that the assembly has become twisted; in these circumstances a new complete assembly should be fitted, and the original assembly returned to Recording Maintenance Unit for straightening by a skilled mechanic in the workshop.

## ELECTRICAL TESTS AND ADJUSTMENTS

### 1. Tests in the Programme Chain

#### *Sensitivity Test*

This test consists of comparing the level recorded at 900 c/s under normal line-up conditions with the standard level on test record DOM 25.

The procedure is as follows:

- (i) Adjust the depth of cut on each machine to obtain an accurate groove-to-land ratio of 2 : 1.
- (ii) Line up the channel on tone in the normal way, so that each recording-head meter registers datum voltage.
- (iii) Record a short band of tone on each machine at a diameter of not less than 6 inches.
- (iv) In a reproducing channel or disk test room, play test record DOM 25 and adjust the peak-programme-meter reading to 4. (If necessary, the test may be carried out in the recording room itself by connecting the monitor amplifier 500-ohm output to the input of one of the recording-head meters.)
- (v) Replace test record DOM 25 by the recorded disk and compare the meter reading with that previously obtained.
- (vi) Where the difference between the readings is greater than  $\pm 1$  db, adjust the recording-amplifier gain-control accordingly and repeat the test.
- (vii) When correct conditions have been obtained, note the reading of each recording-head meter and write this reading in ink on the white tablet beneath the meter.

#### *Frequency-response Test: Reproducing Chain*

- (i) Insert a plug in the L.S. In jack, thus removing the variable-impedance load presented to the monitor amplifier by the loudspeaker.
- (ii) Connect the *Mon. Amp. 500  $\Omega$  Out Jack* to the 600-ohm impedance input of a portable peak programme meter. ~~DOM 85~~
- (iii) Place test record ~~RTF 85~~ on turntable No. 1 and reproduce the outer 1,000-c/s band, at the same time adjusting the reading of the P.P.M. to 4.
- (iv) Reproduce ~~RTF 85~~ and note the readings ~~DOM 86~~

obtained. These readings should be within the tolerances indicated on Fig. 1 of Instruction R.5; if the readings are out of tolerance, the pickup must be adjusted in the manner described in Section A of the above Instruction.

(v) Repeat the procedure for the other turntable.

Note: If a portable peak programme meter is not available, the monitor amplifier output should be connected to one of the recording-head meters instead.

#### *Frequency-response Test: Recording Chain*

A check on recording-head sensitivity must always precede a frequency run on the recording chain, and must also be accompanied by a frequency run on the pickup and reproducing chain which will be used for playing back the test recording.

The equipment required for the present test is as follows:

- (a) Test record ~~XTR 311~~ DOM 85
- (b) A tone-source capable of giving a constant output at frequencies between 10,000 c/s and 1,000 c/s, varied in 1,000-c/s steps, and at 500, 200, 100 and 50 c/s.
- (c) Disk reproducing equipment incorporating an E.M.I. Type-12 pickup, equalised for the BBC recording characteristic and followed by a linear amplifier.
- (d) A peak programme meter or, if not available, the recording-head meter.

Previous to the main tests, where a replacement recording head has been fitted, and the response with this head is being measured for the first time, the frequency characteristic of the recording amplifier should be set initially to rise by  $3\frac{1}{2}$  db at 6,000 c/s relative to 1,000 c/s, as measured on the recording-head meter. This setting, which is controlled by a potentiometer at the rear of the amplifier, may require alteration after the overall frequency-response test has been carried out.

To carry out this test, proceed as follows:

- (i) Switch the radius compensation equalisers to *Off*. Using a 12-inch diameter disk, adjust the depth of cut to give the correct groove-to-land ratio of 2:1 at 78 r.p.m.
- (ii) Connect the tone source to the channel input and, by means of the limiter input attenuator and the tone-source level control, adjust the input at 1,000 c/s to datum voltage as indicated on the recording-head meter. The output from the tone source as measured on the tone-source meter should

subsequently be maintained constant by adjustment of the tone-source level control, but the setting of the limiter input attenuator should be left unaltered throughout the tests.

- (iii) Record a frequency run at 78 r.p.m., taking the frequencies in descending order starting with 10,000 c/s. Each band of tone should last for 10 seconds and be followed by a 5-second pause. The first and last bands should be at 1,000 c/s. The starting diameter should be  $10\frac{1}{2}$  inches.
- (iv) Repeat the complete procedure for the other machine or, alternatively, record on both machines simultaneously.

Reproduce the two disks, and for each turntable speed tabulate the output from the disk in db at each frequency relative to the output at 1,000 c/s. In an adjacent column tabulate similar figures obtained when reproducing ~~XTR 311~~ DOM 85

For each frequency subtract the figure relating to ~~XTR 311~~ from that relating to the test recording, obtaining a new set of figures. These figures, when plotted on a graph, should give a response curve lying between the limits shown in Fig. 19. If the response curve for either machine is outside the tolerance limits, further investigation is required. If the error is at the lower end of the frequency range, the adjustment of the recording-head pivots may require attention; if the error occurs at the upper frequencies, it may happen either that a resonance appears, or that the upper-frequency end of the curve as a whole is placed either too high or too low. The existence of a marked resonance indicates that the recording head may require re-damping; this operation is described in an appendix to Instruction R.2. General raising or lowering of the upper end of the response curve to bring it into tolerance can be effected, if required, by adjustment of the frequency-correction control at the back of the recording amplifier. The response at the highest frequencies is affected by the shape and dimensions of the recording and reproducing styli; these styli should, if necessary, be changed and the tests repeated. If it proves impossible by any of the above means to bring the response curve within the set tolerance limits, the recording head itself is probably faulty, and should be replaced.

## 2. Routine Maintenance

### *Cleaning of Electrical Contacts*

It is important to keep all moving electrical contacts absolutely clean. Contacts of particular im-

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portance in this respect are those on the radius-compensator slider and the recorder input switch.

The cleaning fluid (Servisol) supplied by Recording Maintenance Unit not only contains solvents for dirt but also embodies a lubricating agent. The radius compensator should be cleaned with this using a lint-free cloth (not mutton-cloth). If the atmosphere in the recording room is dusty the slider will require daily attention.

The Yaxley-type switches, if at all worn, are not easy to keep clean. For these a small brush should be used to apply the cleaning fluid.

#### *Amplifiers*

Valve data for the amplifiers are included in Section C. The amplifiers on Type-6N equipment should be checked with a Universal Avominor and those on the Type-8N equipment with a Universal Avometer Model 40. The ranges to be used are specified in the data. An appreciable variation may be expected between measurements obtained on different individual amplifiers.

The cathode-current feed-metering jacks provided on the Type-8N equipment are of the miniature type, requiring special plugs. The current readings on the Avometer Model 40 are arbitrary, and depend on the known resistance of the meter and the shunts in the amplifier cathode circuits.

Trouble on amplifiers may be due to pairs of push-pull valves not being satisfactorily matched. The remedy is to select a pair having similar values of anode current and mutual conductance, and to try them in the amplifier, changing one or the other if trouble is experienced. Valves which are out of balance may cause distortion or excessive hum level. On limiter amplifiers, plops and cut-backs may also be produced, and for this reason a special balance control is provided. (See below).

For routine testing of valves, the latter should be removed and checked on a valve tester.

#### *Balancing of Limiter Input Stage*

Unbalance in the first stage of the limiter can have very serious results, since the a.v.c. voltage

is injected into this stage. To ensure satisfactory balancing, a potentiometer R6 is provided in the cathode circuit between V1 and V2, as shown in Fig. 6. For testing purposes the a.v.c. line is broken at a jack, so that pulses can be injected from a portable test-signal generator. This instrument, which is provided at all stations, takes the form of a simple relaxation oscillator (Fig. G.1) embodying a neon tube.

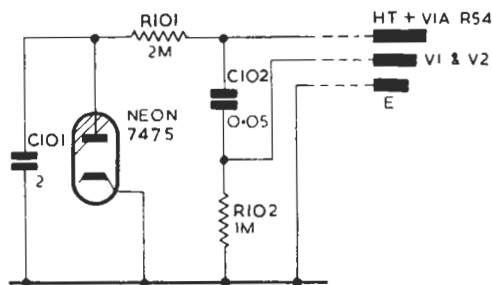


Fig. G.1. Balance-test Oscillator

When the oscillator is plugged in, C101 charges from the limiter h.t. supply through R101 (Fig. G.1) and R54 (Fig. 6). As soon as the neon striking voltage is reached, C101 discharges and immediately begins to charge again. This cycle of events is repeated two or three times a second. A small part of the change in voltage occurring across the neon is tapped off by the potential divider R54, R101, and applied to the differentiating circuit C102, R102, which sharpens the generated pulse to make its waveform resemble that of an a.v.c. signal.

To carry out a balance test, plug the oscillator to the jack at the rear of the limiter chassis, and connect together the *Lim. Out* and *Mon. In* jacks by means of a double-ended cord. Adjust the monitor amplifier gain until plops can be heard on the loudspeaker. Then vary the balance control, which is on top of the limiter chassis, until the low-frequency component of the plops is at a minimum.

## SECTION H

### ROUTINE MAINTENANCE OF SWARF REMOVAL EQUIPMENT

#### General Considerations

Apart from regular emptying of the swarf container, and the necessity for cleaning the bore of the suction-nozzle, the principal maintenance requirements of the equipment concern the pump and filter/silencer unit and the pump motor. The scope of the maintenance work which can be undertaken by station staff is, however, limited to operations of a routine nature. It is necessary to give a warning here that dismantling of the vane-pump may result in serious damage unless carried out by a mechanic skilled in this particular type of work, and should not be attempted by anyone else. The pump is nevertheless extremely robust in service, and may be expected to have a long and trouble-free life provided that it is adequately supplied with oil and not interfered with.

The following operations come under the heading of routine maintenance, and should be carried out by local station staff:

- (a) Removing accumulations of swarf.
- (b) Renewal of nozzle-silencing elements.
- (c) Adjusting the drive-belt tension.
- (d) Lubrication of the pump motor.
- (e) Checking and maintaining the level of the oil in the pump outer casing.
- (f) Renewing the cartridge element in the exhaust filter/silencer when the absorbent medium has become saturated with oil.

#### Swarf Accumulations

##### *Swarf Container (Fig. 16)*

The swarf container for each machine should be cleared daily, as an accumulation of swarf in the container reduces the efficiency of the equipment and increases the fire risk.

##### *Nozzle Tube (Figs. 14 and 15)*

After a considerable period of use, a coating of swarf dust collects inside the nozzle tube, and should be removed by pulling a strand of knitting wool through the tube. Since the tube and nozzle are relatively fragile, and their bore is highly polished to reduce air friction, the employment of any cleaning medium harsher than wool, for example string or wire, is highly undesirable and may easily lead to scratching of the bore or deformation of the nozzle.

In order to clean the tube, first withdraw the nozzle-silencing elements. (These consist of two short strands of wool, which on the SRE/1 have eyelets at one end for attachment to the nozzle saddle-clamp, and on the SRE/2 are fastened to the upper side of the tube itself by a clip.) Now take a three-foot length of wool and, holding it at one end, allow the remainder of the wool to be drawn into the tube by suction. Then detach the nozzle tube from the rubber pipe leading to the swarf container, so that the length of wool can be pulled backwards and forwards through the tube. After cleaning the tube and, if necessary, renewing the silencing elements, restore the latter to their positions inside the nozzle by use of the suction.

##### *Pump Inlet Filter (Fig. 18)*

Swarf dust also tends to collect in the wire-gauze filter at the pump inlet. This filter is located between two flanges, one on the inlet tube (Fig. 18) which projects vertically from the top of the pump casing, and the other on the boss to which the large-diameter rubber hose (not shown in Fig. 18) is attached. The presence of swarf at this point is indicated by a deterioration in the performance of the equipment persisting after all obvious causes have been removed.

To obtain access to the filter, remove the three socket-screws holding the flanges together, and separate the flanges taking care not to damage the gasket which is used to make the joint airtight.

##### *Driving Motor and Belt (Fig. 18)*

###### *Motor Lubrication*

The bearing at each end of the motor should be lubricated monthly with a few drops of thin oil.

###### *Driving Belt*

After completion of the running-in period, the rubberised-canvas driving belt will require adjustment, in order to take up initial stretch. To make the adjustment, loosen the four bolts by means of which the slotted feet of the motor are clamped to the bed-plate, and move the motor further away from the pump.

When the position of the motor is correctly adjusted, the belt should pass round the pulleys without sagging, but should give slightly if the upper

## INSTRUCTION R4

### Section H

and lower parts are pulled together at the centre of their span. To minimise belt wear the two pulleys must be in line and their axes must be parallel.

#### Suction Pump (Fig. 18)

##### *General*

The suction pump, which is provided with vertical cooling fins and is partially immersed in oil, is a separate unit fitting inside the square outer casing shown at the left-hand end of the bed-plate in Fig. 18. A gasket is cemented between the top and body of the casing to make an air- and oil-tight joint.

The air inlet tube previously mentioned is connected inside the casing to the pump intake. The tube enters the casing through a round-section Neoprene gland-washer providing the necessary seal to the atmosphere, and has a flange by means of which it is bolted to the top of the casing.

Due to the high back pressure inside the casing, if the cover top and inlet tube are once disturbed, re-fitting and re-making the seals requires extreme care if oil leakage is to be avoided. For this reason it is important that neither the cemented-gasket joint nor the inlet-tube gland be interfered with.

##### *Oil Level*

For purposes of lubrication, the pump at each revolution takes up from the reservoir in the outer casing a measured quantity of oil; this oil is discharged from the pump as a fine vapour, and is subsequently trapped in the exhaust filter. The oil level in the pump casing should be checked at monthly intervals by means of the dip-stick provided, the oil-gauge window in the side of the casing being ignored.

In order to insert the dip-stick, which passes between cooling fins, unscrew the hexagonal-headed filler plug. This plug, shown in Fig. 18 immediately to the right of the air inlet, is provided with a packing ring which must be treated with care if the equipment is to remain airtight. The maximum and minimum levels for the oil are indicated by two gauge marks on the dip-stick, and the sump must be replenished when necessary with Castrol grade XXL oil. It is of the utmost importance that the correct oil level be maintained, since overfilling with oil

causes rapid saturation of the exhaust-filter element, while extremely serious damage to the pump mechanism can be caused by lack of adequate lubrication.

##### *Overhauls*

Overhauls to the pump should not be attempted locally, but if trouble develops a replacement assembly should be obtained from Recording Maintenance Unit and the faulty one returned for repair.

#### Exhaust Filter/Silencer (Fig. 18)

##### *General Arrangement*

The exhaust air from the pump, containing oil vapour, passes through the curved exhaust pipe shown in Fig. 18 to the inlet port in the head casting of the exhaust filter/silencer. From this point the air is led down through the filter cartridge element, which is a vertical cylinder filled with an oil-absorbent and silencing medium, to the bottom of the container and then up between the outside of the cartridge and the container walls to the outlet port in the head. The path of the exhaust air through the filter/silencer is indicated by arrows in Fig. H.1.

The head casting is bolted through a gasket to the side of the pump outer casing.\* A spun-metal outer container for the filter element is secured beneath the head by a clamping ring and six hexagon bolts, a Neoprene ring recessed into the underside of the head ensuring an air- and oil-tight joint. The filter cartridge inside the container has a neck-opening at the top and a further opening at the bottom, both protected by perforated-metal screens. Around the neck-opening is a second Neoprene ring which is pressed upwards against the mouth of the inlet pipe in the head by two coil springs in the base of the container.

NOTE.—Two slightly different kinds of filter/silencer-head casting are in use. On the first equipments installed, the inlet port was at the rear and the outlet port on the front, as in Fig. 18, but on the majority of equipments at present in service the positions of the ports are reversed; the latter arrangement applies to the head casting in Fig. H.1, although neither of the internal openings leading to the ports is visible in the centre-line cross-section

\*In order to detach the filter/silencer head casting from the side of the pump outer casing it is necessary to gain access to the bolt-heads which are inside the casing. As this involves removing the top of the casing and thereby breaking essential seals which, as mentioned earlier, are difficult to remake, the operation must not be attempted by station staff.

## INSTRUCTION R4

### Section H

shown. On any future deliveries from the manufacturers the original arrangement of the ports will be restored.

blocking either the inlet to the pump itself or else the suction-nozzle orifice on the recorder. If the air intake is then suddenly unblocked, a small puff of oil

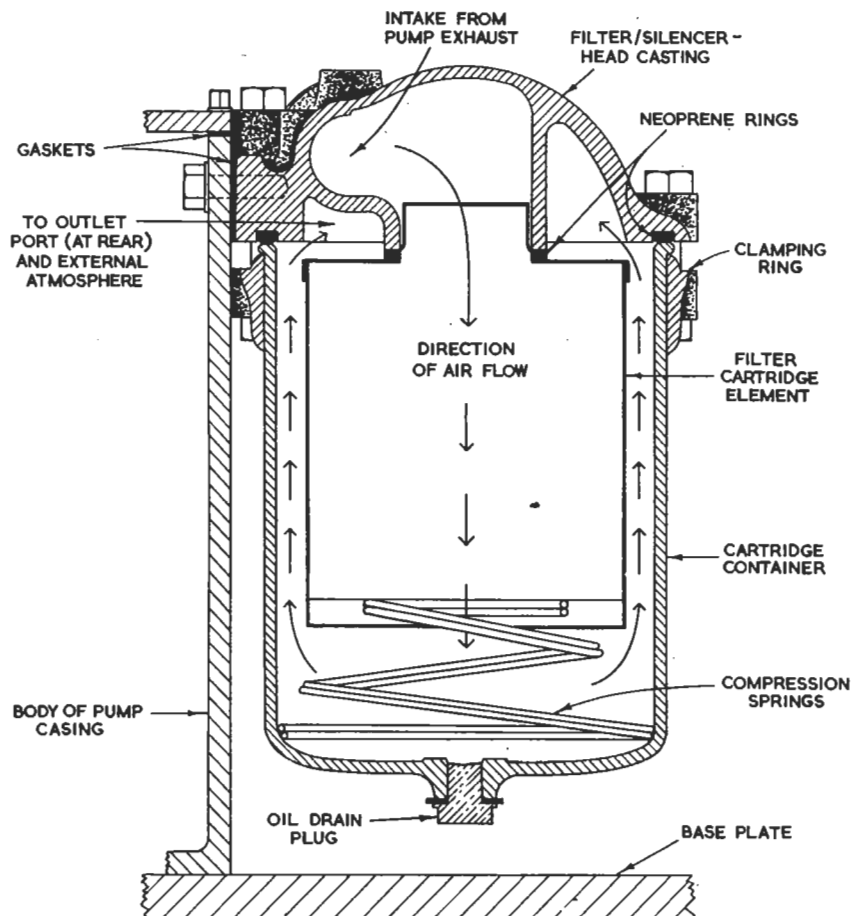


Fig. H.1. Exhaust Filter/Silencer: Simplified Sectional View

#### Filter Performance

If the level of the oil in the pump casing is correctly maintained, the element remains serviceable for about one thousand hours of running. When the end of the element's useful life is approached, the oil vapour is no longer completely absorbed, but is in part released to the atmosphere.

To check whether or not the filter element needs renewing, switch on the pump motor and shut off the air intake to the pump for several seconds by

vapour will be seen at the outlet port on the filter/silencer head when the element is saturated.

#### Replacement of Filter Cartridge Element (Fig. H.1)

Before removing the used element, place a shallow vessel under the drain-hole of the container and unscrew the drain-plug to release the oil. An accumulation of rather more than half a pint may normally be expected after a thousand hours of running.

After withdrawing the vessel containing the re-

## INSTRUCTION R4

### Section H

leased oil, support the filter-cartridge container from beneath and unscrew the six hexagon bolts round the filter/silencer head, so that the container and clamping ring are forced downwards away from the head by the coil springs inside the container. Allow the container to drop gently until it rests on the main base-plate: the cartridge element itself will remain held against the head by the springs, and should be pressed downwards into the container with the fingers until the cartridge and container can be withdrawn sideways.

Discarding the used element, wipe the inside of

the container to remove any oil. Place a fresh cartridge in the container, and holding it down against the springs, insert the cartridge and container under the head. Allow the cartridge to rise, being careful to ensure that its neck enters the central tubular aperture in the underside of the head. Press the clamping ring and container against the head and fasten by means of the six bolts. Care must be exercised to avoid over-tightening these bolts, since it is a relatively easy matter to fracture the lugs on the aluminium head and ring castings.

*June 1952.*

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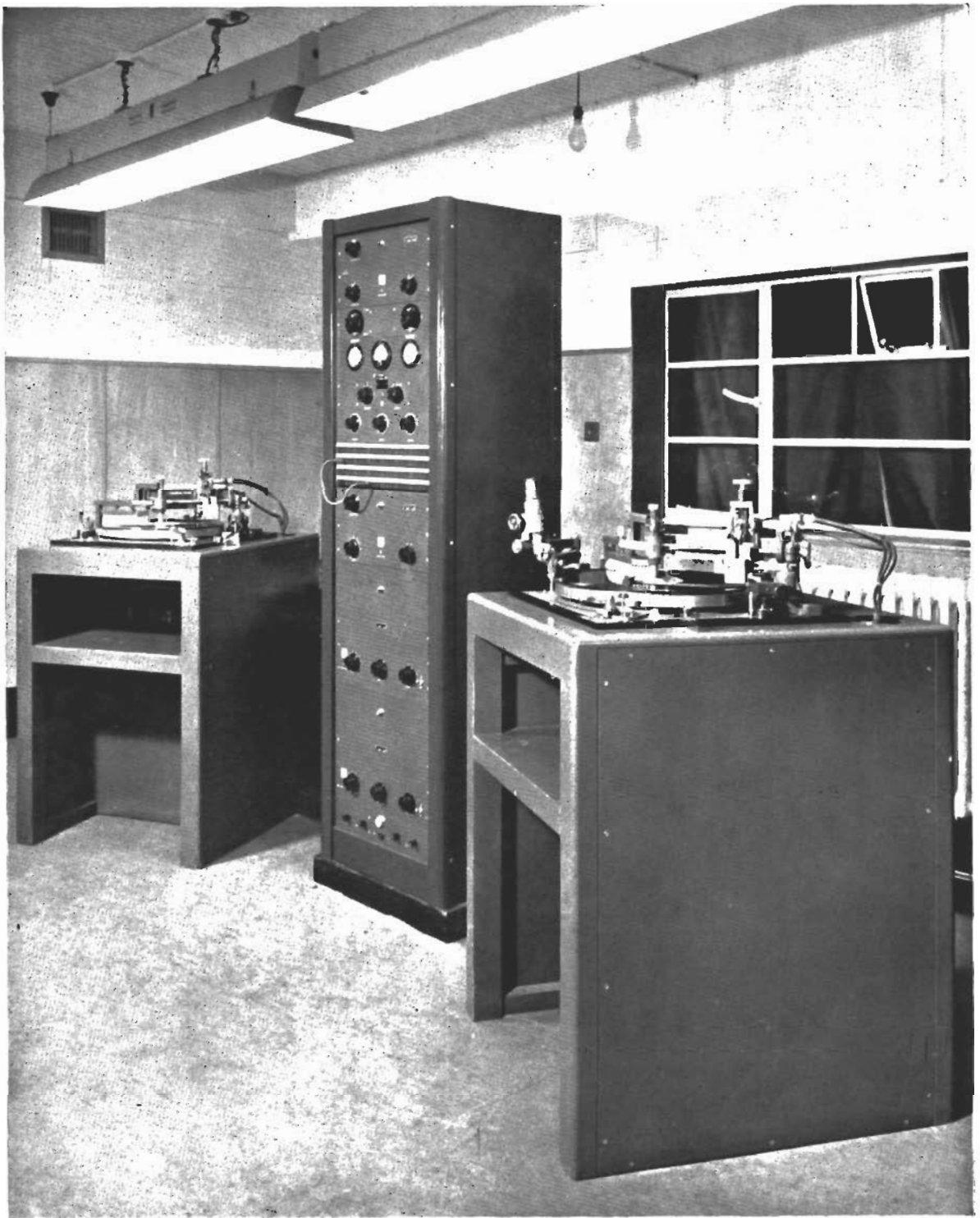


*Fig. 1. Presto Recording Channel: General Arrangement*

# KEY TO FIGS. 2 AND 3

| Item | Description                                      |
|------|--------------------------------------------------|
| 3    | Traversing Carriage.                             |
| 7    | Recording-head Adjustment Spring (Depth of Cut). |
| 8    | Lead-screw.                                      |
| 9    | Elbow Joint.                                     |
| 10   | Traverse-engage.                                 |
| 11   | Lead-screw Release.                              |
| 12   | Hand Traverse.                                   |
| 13   | Traverse Blade.                                  |
| 14   | Recording-head Bracket Pivot.                    |
| 15   | Extension Lever for Recording-head Bracket.      |
| 16   | Raise-lower Lever.                               |
| 17   | Oil Dash-pot.                                    |
| 17A  | „ „ Positioning Device.                          |
| 18   | „ „ Plunger.                                     |
| 19   | Depth-of-cut Adjusting Nut.                      |
| 26   | Radius-compensator Attenuator Slider.            |
| 27   | „ „ Resonant-circuit Slider.                     |
| 28   | „ „ Slider Barrel.                               |
| 29   | Hand-grip.                                       |
| 30   | Traversing Bar.                                  |
| 31   | Traverse-supporting Bar.                         |
| 32   | Recording-head Bracket.                          |
| 33   | „ „ Securing Screw.                              |
| 36   | Traverse-driving Boss.                           |
| 37   | Worm-wheel Shaft Retaining Screw.                |
| 38   | Traversing-worm Cover.                           |
| 39   | „ „                                              |
| 40   | „ „ Wheel.                                       |
| 41   | „ Ratchet Housing.                               |
| 42   | „ „ Retaining Screws.                            |
| 43   | „ „ Oil Hole.                                    |
| 44   | „ Assembly Frame-releasing Bolt.                 |
| 45   | „ „ Support Pillar.                              |

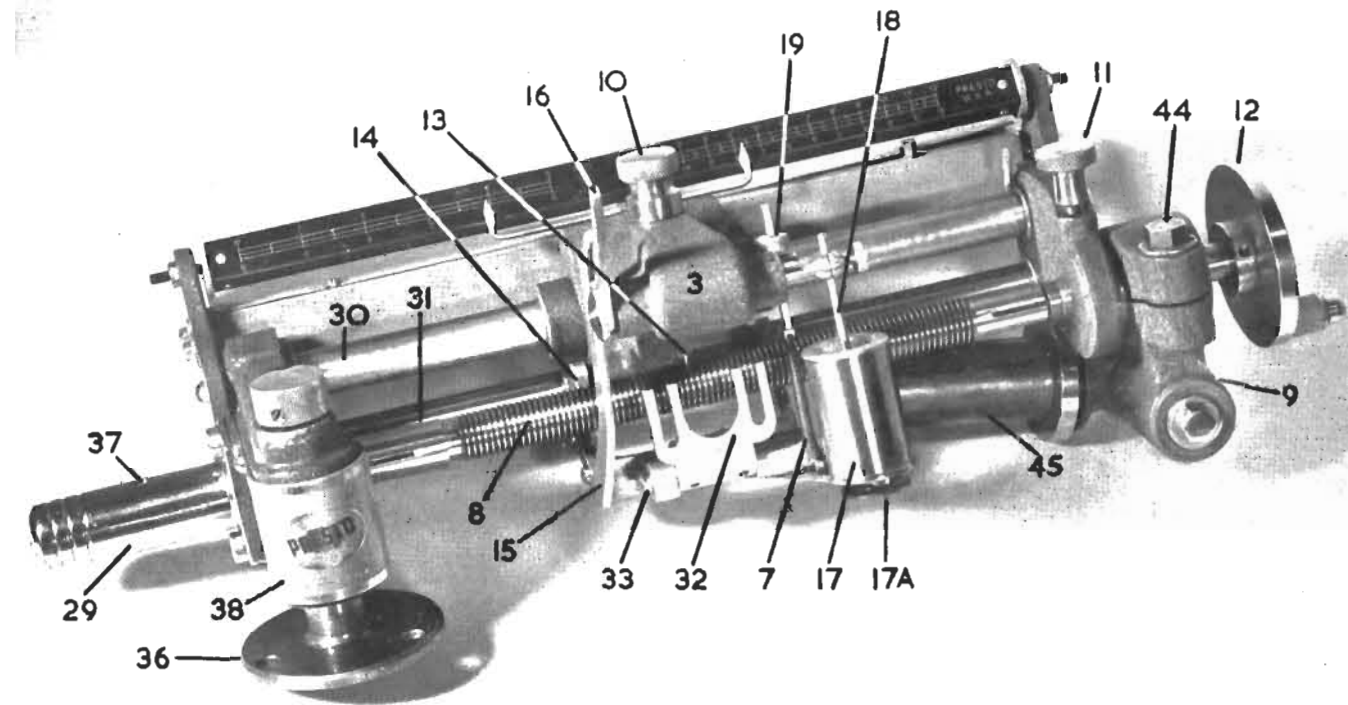


Fig. 2. Traversing Assembly Type 6-N: Front View

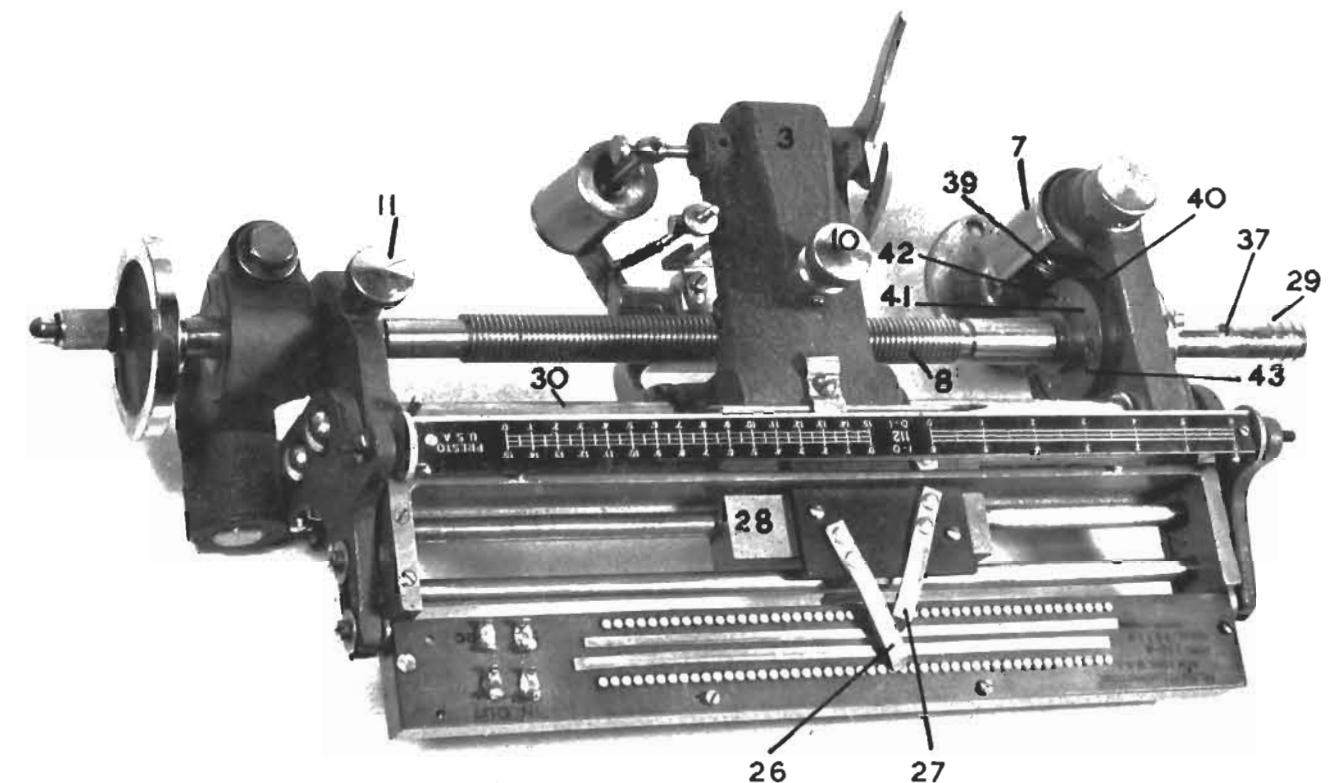


Fig. 3. Traversing Assembly Type 6-N: Rear View

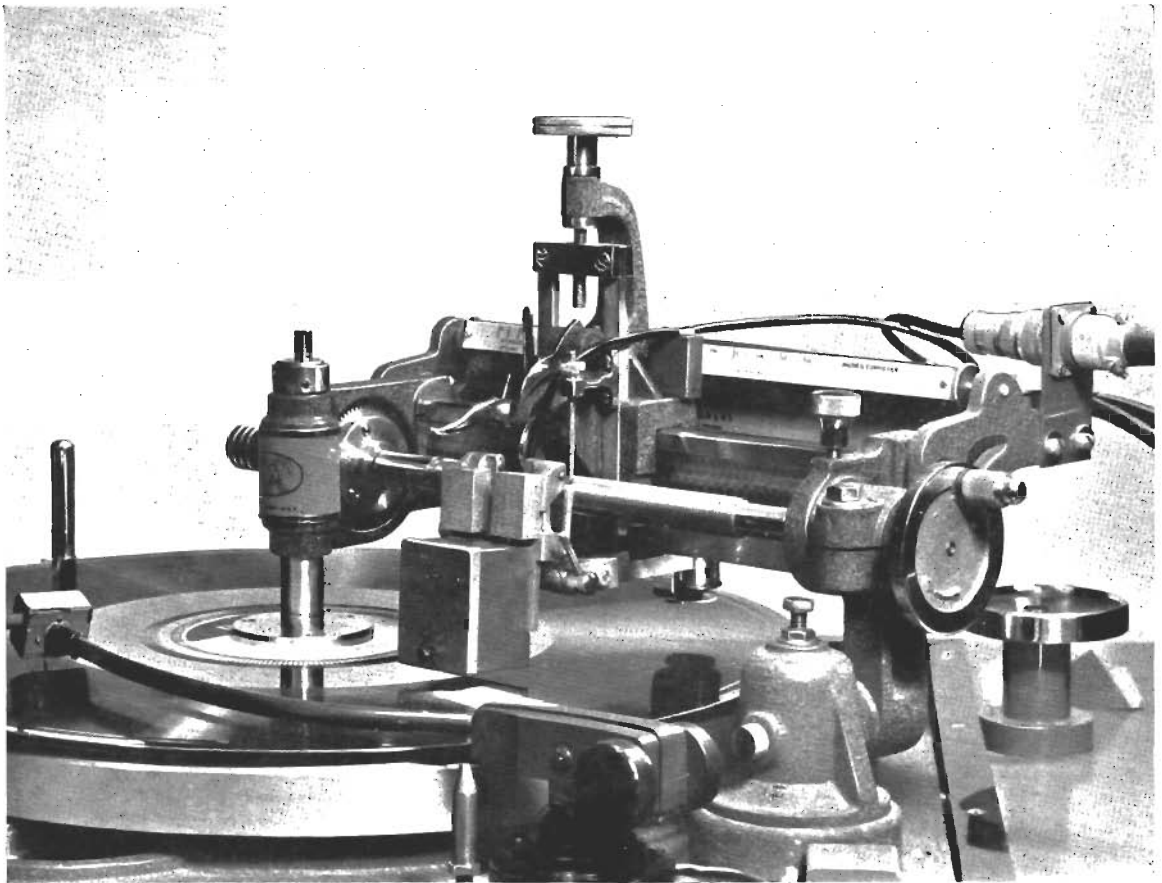
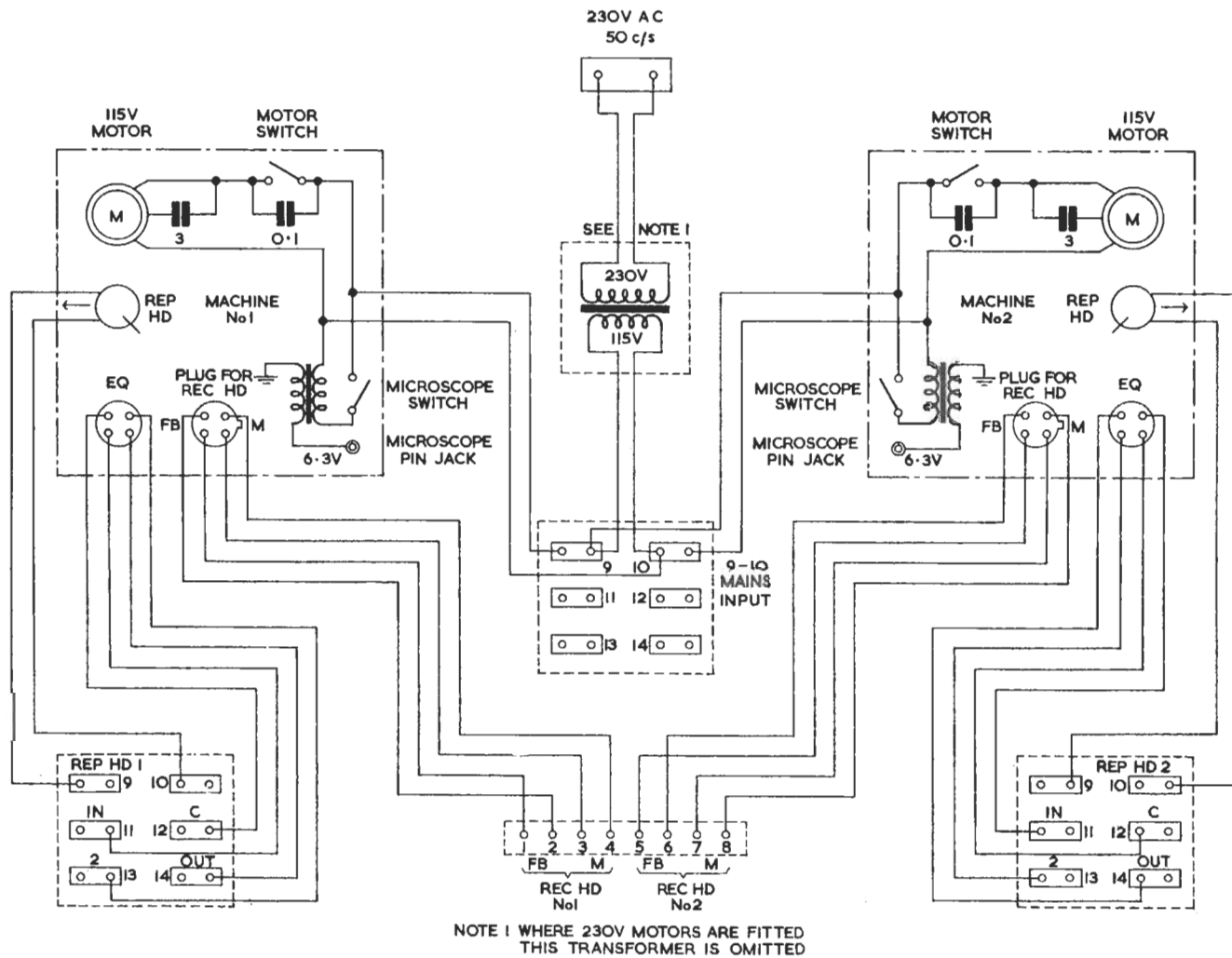
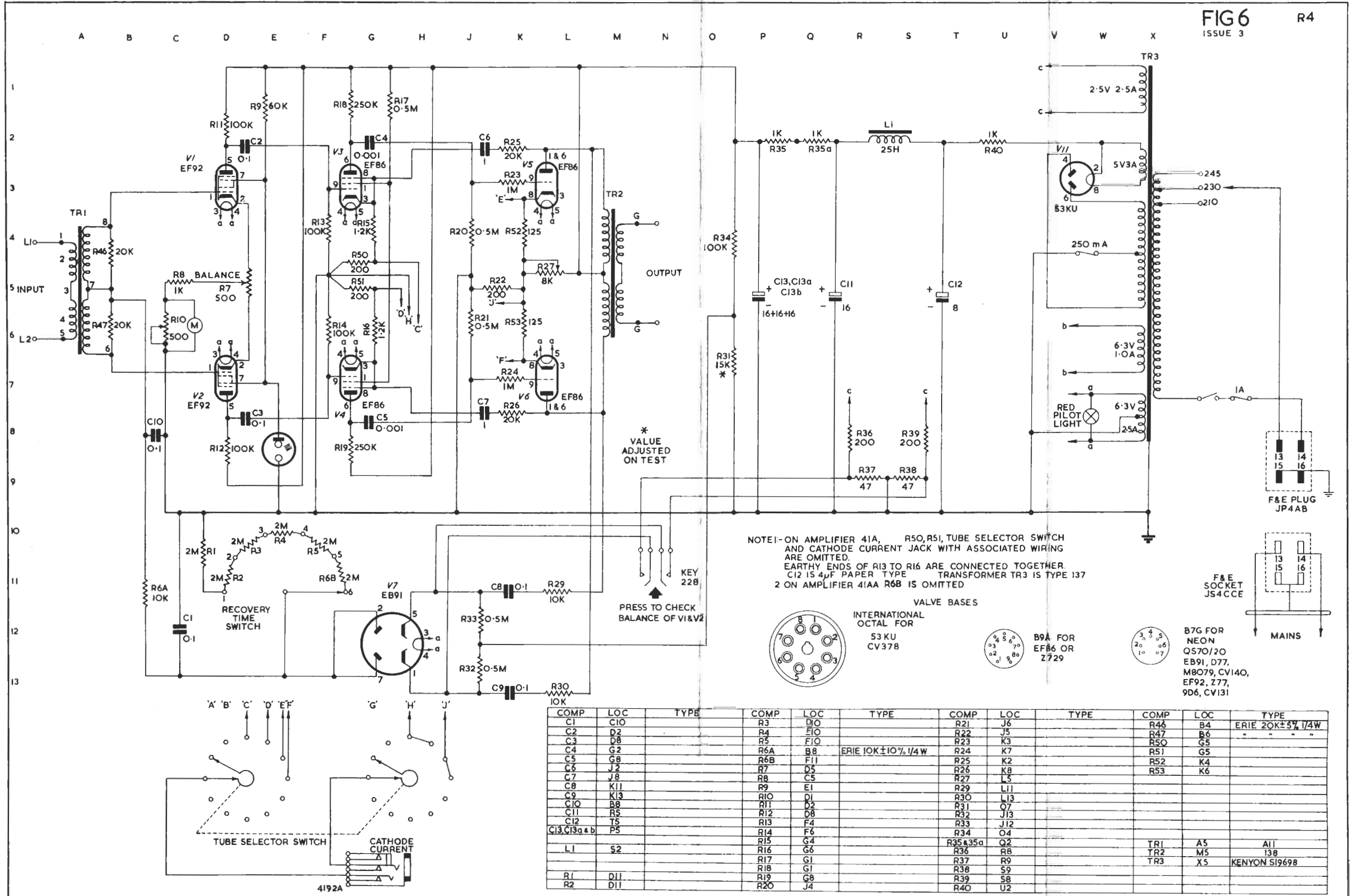


*Fig. 4. Presto Type 8-N Recorder  
Traverse Mechanism Type-8NA*



PRESTO RECORDING CHANNEL TYPE AB  
CIRCUIT OF RECORDING MACHINES

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PRESTO LIMITER AMPLIFIERS 41A & 41AA

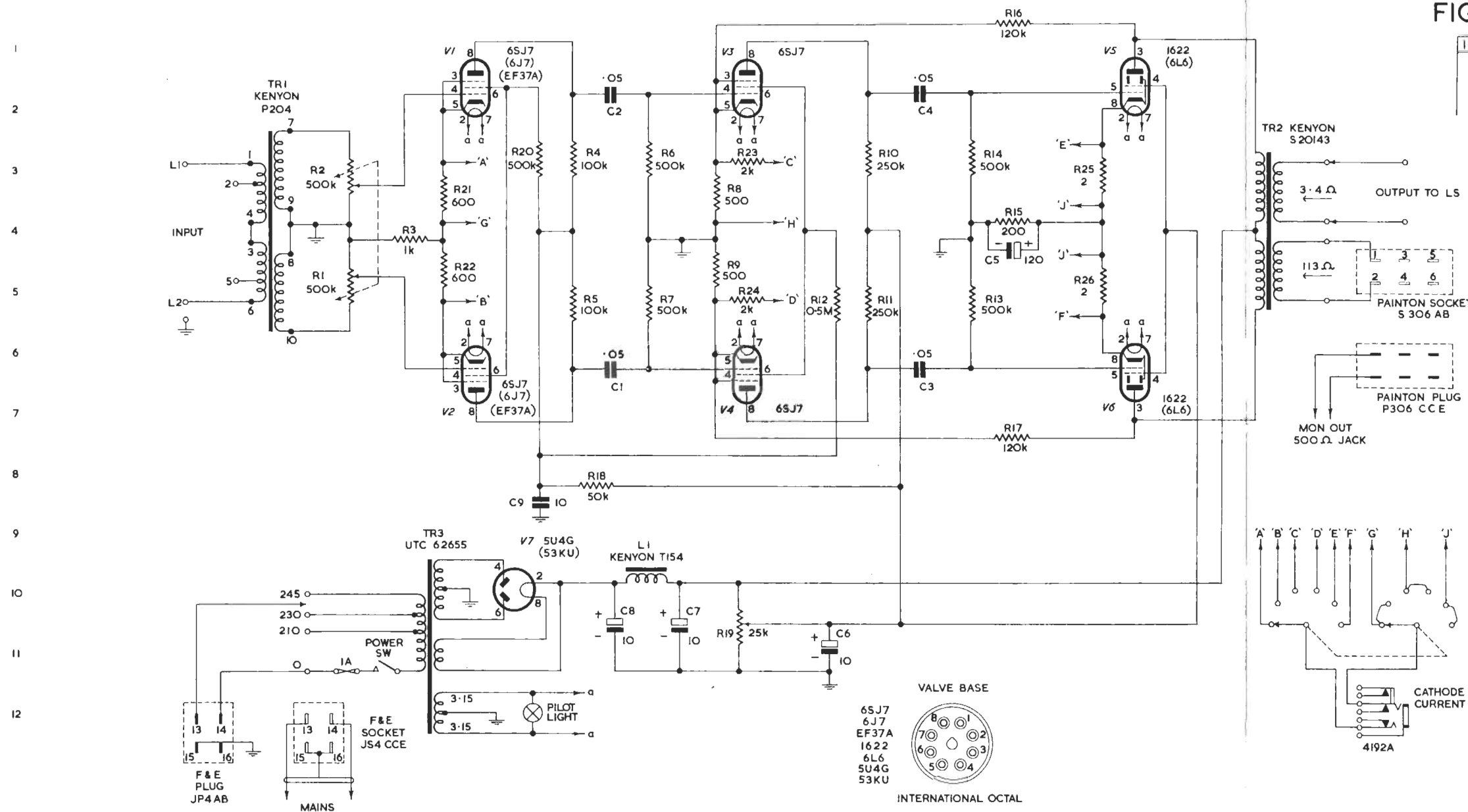
SD/LF1/2322

51/GWH/112/DJE

R4

FIG.7

| ISSUE | AMENDMENT                                              |
|-------|--------------------------------------------------------|
| 3     | EF37A ADDED<br>AS REPLACEMENT<br>FOR 6J7<br>V7 WAS 5Z3 |



| COMP | LOC | TYPE | COMP | LOC | TYPE | COMP | LOC | TYPE          |
|------|-----|------|------|-----|------|------|-----|---------------|
| C1   | K6  |      | R2   | E3  |      | R17  | Q7  |               |
| C2   | K2  |      | R3   | F4  |      | R18  | J8  |               |
| C3   | P6  |      | R4   | J3  |      | R19  | M11 |               |
| C4   | P2  |      | R5   | J5  |      | R20  | H3  |               |
| C5   | Q4  |      | R6   | L3  |      | R21  | G4  |               |
| C6   | O11 |      | R7   | L5  |      | R22  | G5  |               |
| C7   | L11 |      | R8   | M3  |      | R23  | M3  |               |
| C8   | K11 |      | R9   | M5  |      | R24  | M5  |               |
| C9   | J9  |      | R10  | O3  |      | R25  | S3  |               |
|      |     |      | R11  | O5  |      | R26  | S5  |               |
|      |     |      | R12  | N5  |      |      |     |               |
|      |     |      | R13  | Q5  |      |      |     |               |
|      |     |      | R14  | Q3  |      |      |     |               |
|      |     |      | R15  | Q4  |      |      |     |               |
| R1   | E5  |      | R16  | Q1  |      |      |     |               |
|      |     |      |      |     |      | TR1  | D3  | KENYON P204   |
|      |     |      |      |     |      | TR2  | V3  | KENYON S20143 |
|      |     |      |      |     |      | TR3  | G10 | UTC 62655     |

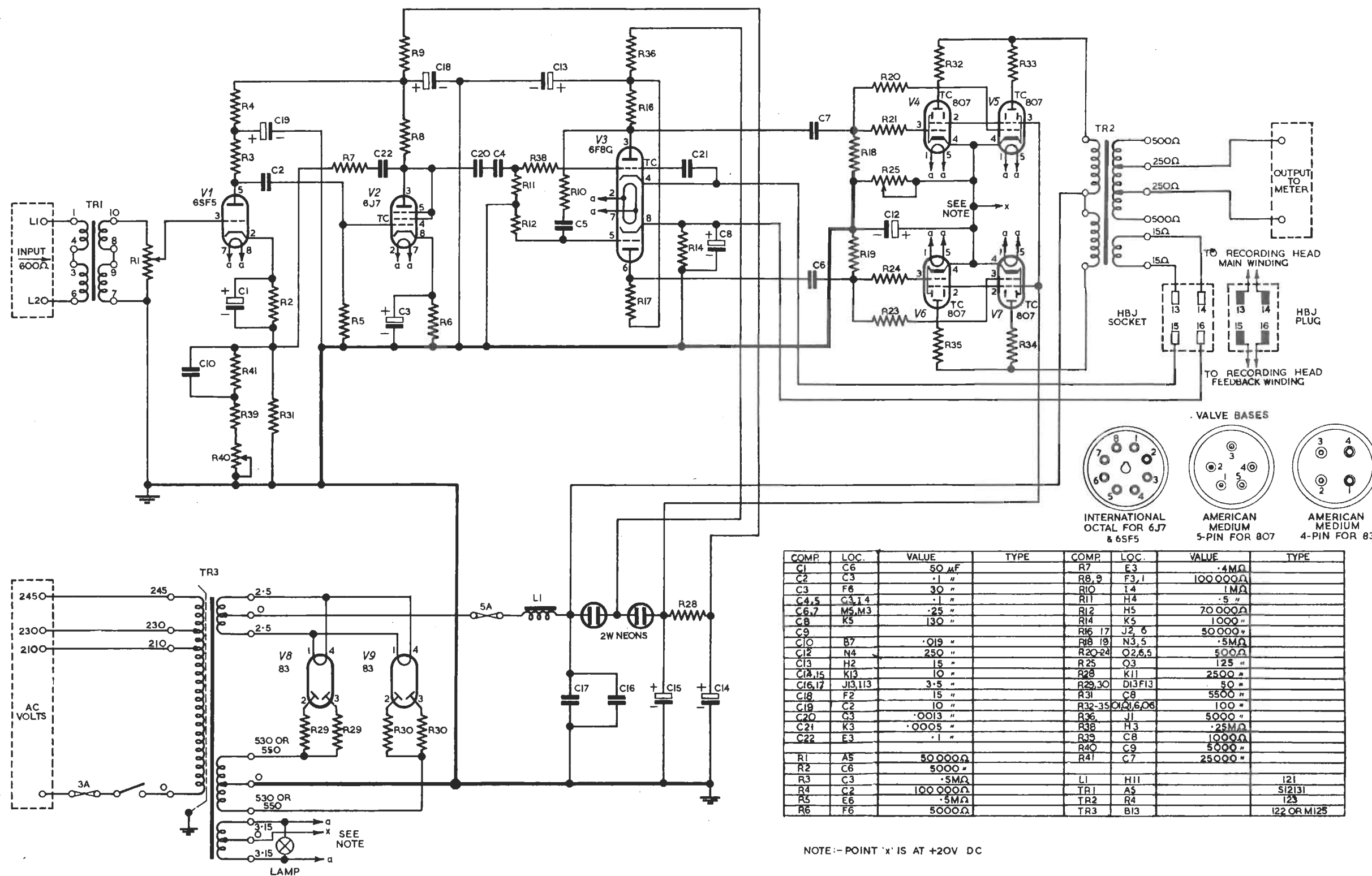
NOTE:- ON AMPLIFIER 89A THE CATHODE-CURRENT METERING CIRCUITS AND R21-R26 ARE OMITTED, TR1 IS 512091, TR3 IS 135

PRESTO MONITOR AMPLIFIERS 89A &amp; 89AA

FIG. 8

SD/LF3/1181

54074/R4 /DJE



NOTE:- POINT 'x' IS AT +20V DC

## PRESTO RECORDING AMPLIFIER 88AB



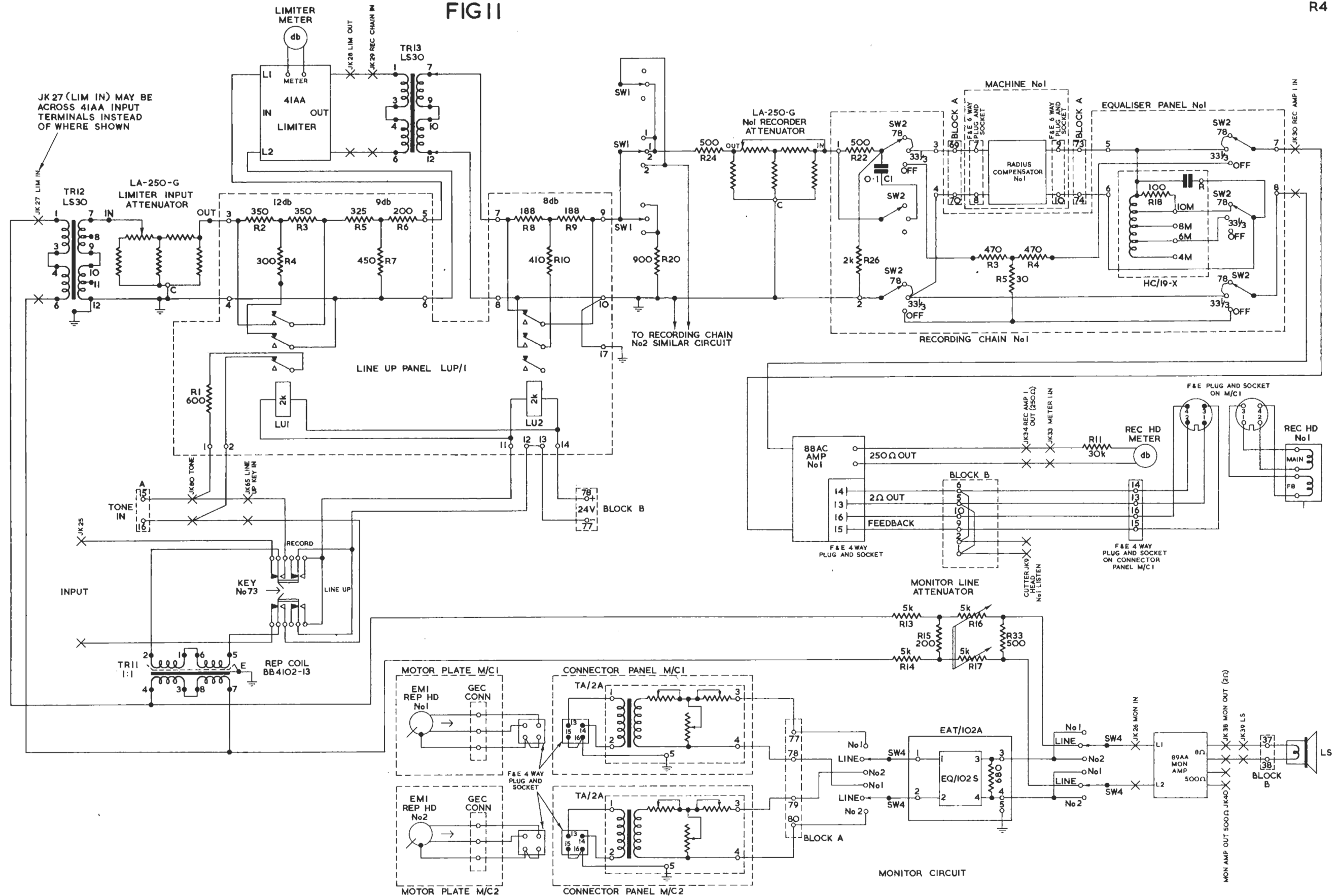
| COMP  | LOC | TYPE                               | COMP | LOC | TYPE             |
|-------|-----|------------------------------------|------|-----|------------------|
| C1    | D10 | TCC 'MICROPACK' 12V DC             | R18  | J6  |                  |
| C2    | D5  |                                    | R16  | R3  |                  |
| C3    | Q8  |                                    | R17  | L3  |                  |
| C4    | H5  |                                    | R18  | P4  |                  |
| C5    | M5  |                                    | R19  | P7  |                  |
| C6    | O8  |                                    | R20  | P3  |                  |
| C7    | O4  |                                    | R21  | P4  | ERIE 0.25W ±10%  |
| C8    | M8  |                                    | R23  | P8  |                  |
| CO    | B7  | TCC 'MW' ±10%                      | R24  | Q7  | " " "            |
| COA B | Q6  | PLUG IN CAPACITOR, AEROVOX P07 25V | R25  | P5  |                  |
| C13   | J2  |                                    | R28  | T11 |                  |
| C14   | T13 |                                    | R29  | L12 |                  |
| C15   | S13 |                                    | R30  | L14 |                  |
| C16   | P13 |                                    | R31  | D7  |                  |
| C18   | H2  |                                    | R32  | Q2  |                  |
| C19   | E3  |                                    | R33  | S2  |                  |
| C20   | H5  |                                    | R34  | S9  |                  |
| C21   | J6  |                                    | R35  | P9  |                  |
| C22   | F4  |                                    | R36  | V2  |                  |
| C23   | U5  |                                    | R39  | C8  | ERIE 0.5W ±10%   |
| C24   | U6  |                                    | R40  | C9  | MORGANITE LINEAR |
| L1    | O11 | KENYON 1970B                       | R41  | C7  | ERIE 0.5W ±10%   |
|       |     |                                    | R42  | G8  |                  |
|       |     |                                    | R43  | N9  |                  |
| R1    | B6  |                                    | R44  | N7  |                  |
| R2    | D9  |                                    | R45  | R5  |                  |
| R3    | O4  |                                    | R46  | R6  |                  |
| R4    | D3  |                                    | R47  | R5  |                  |
| R5    | F7  |                                    | R48  | S6  |                  |
| R6    | G7  |                                    | R49  | D10 | ERIE 0.5W ±10%   |
| R7    | F4  |                                    | R50  | R13 | " 2W "           |
| R8    | G3  |                                    |      |     |                  |
| R9    | G2  |                                    | TR1  | A6  | UTC L5 10X       |
| R10   | L5  |                                    | TR2  | U5  | KENYON 19707     |
| R11   | H7  |                                    | TR3  | K12 | " 19703          |
| R12   | L7  |                                    |      |     |                  |
| R14   | VR  |                                    |      |     |                  |

NOTES 1. POINT 'x' IS AT +20V DC  
2. PINS 1,4&5 OF VI (DH63)  
CONNECTED TO CHASSIS

## PRESTO RECORDING AMPLIFIER 88A C & 88AB

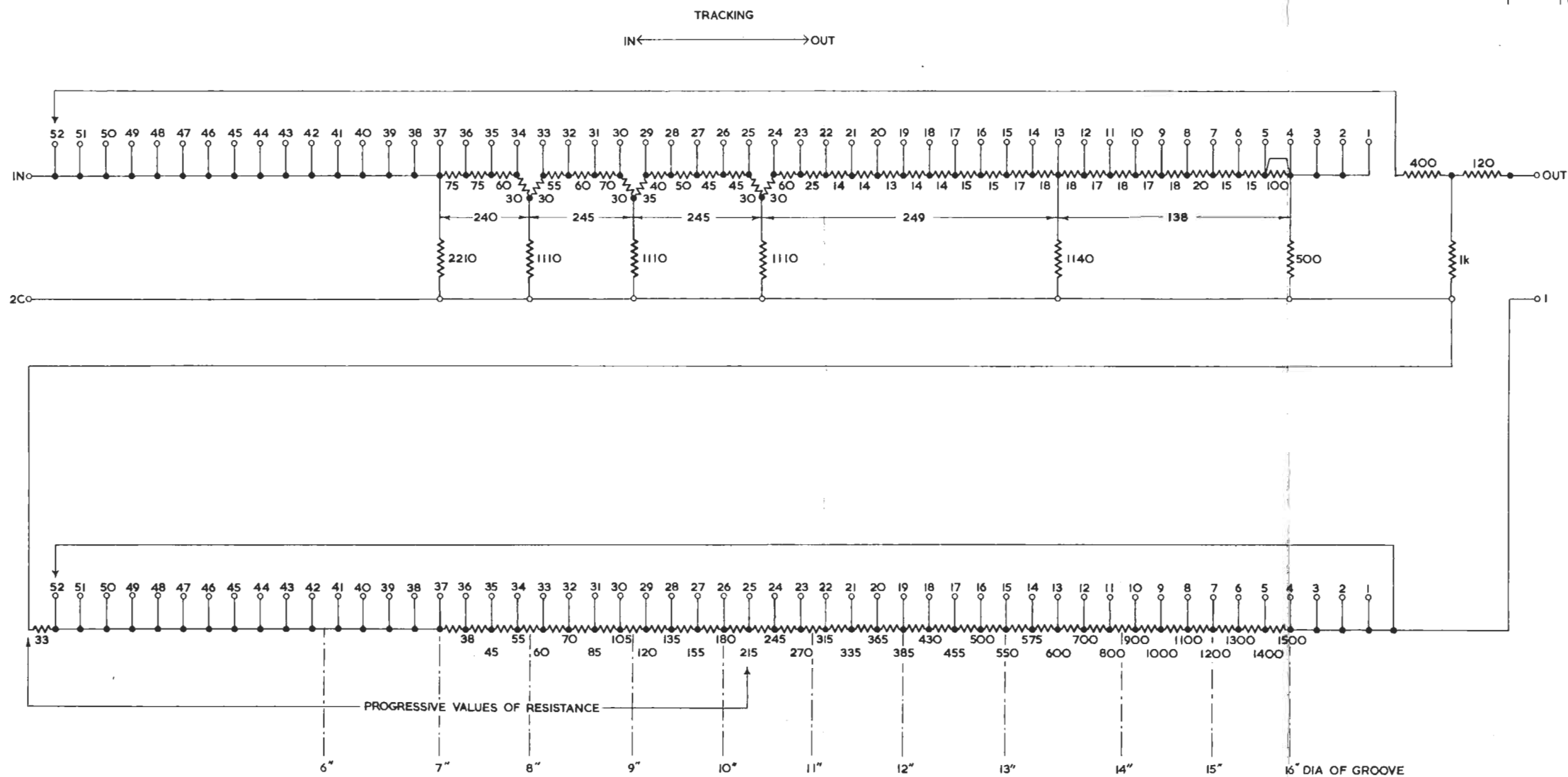


FIG 11

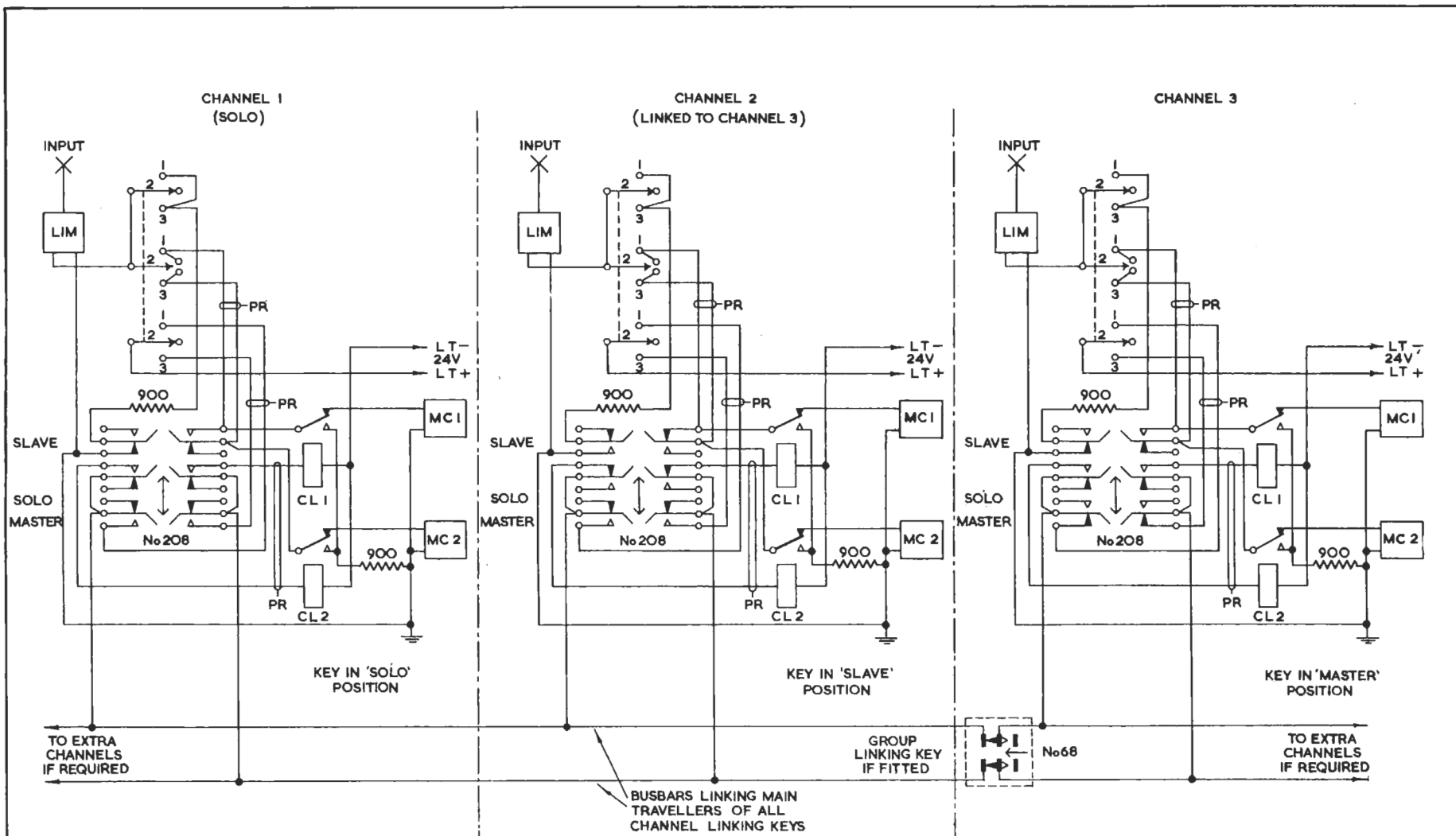


PRESTO RECORDING CHANNEL TYPE JC: PROGRAMME CIRCUIT

| ISSUE | AMENDMENT                                                                                                  |
|-------|------------------------------------------------------------------------------------------------------------|
| 3     | STRAP BETWEEN 400Ω RESISTOR AND TERMINAL 1 REMOVED. GROOVE DIA ADDED. VALUE OF RESISTORS 18 TO 100 WAS 240 |



PRESTO RADIUS COMPENSATOR ATTENUATOR CIRCUIT



PRESTO CHANNEL LINKING: GENERAL ARRANGEMENT

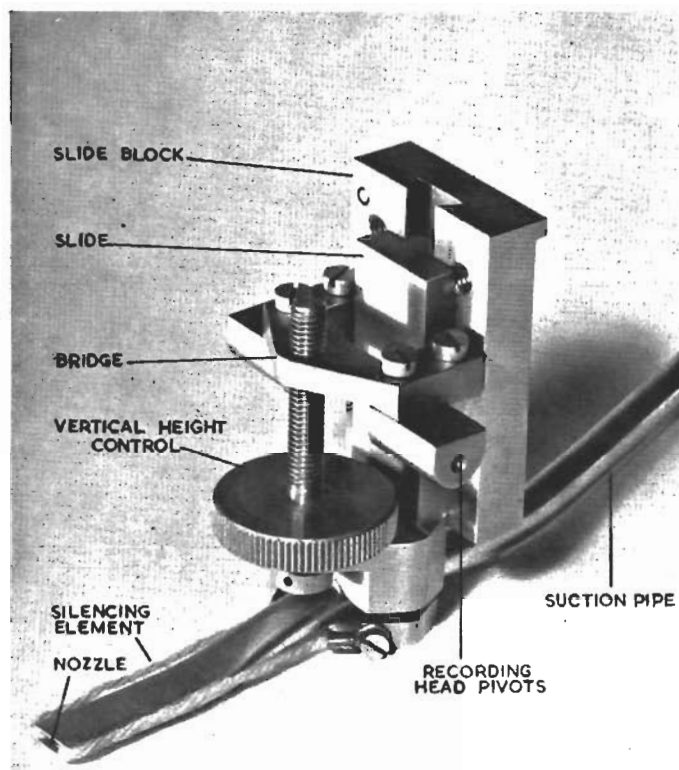


Fig. 14. Nozzle Assembly for SRE 1  
Used with Type-8N Recorder

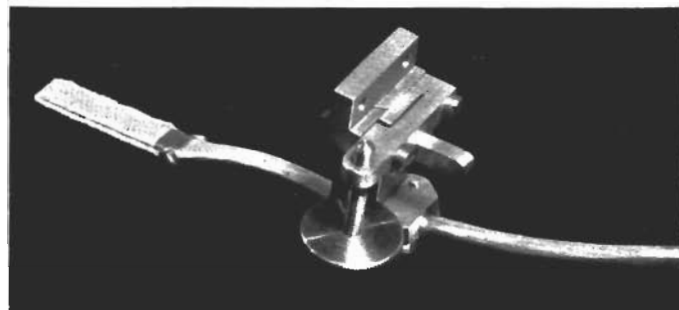


Fig. 15. Nozzle Assembly for SRE 2  
Used with Type-6N Recorder

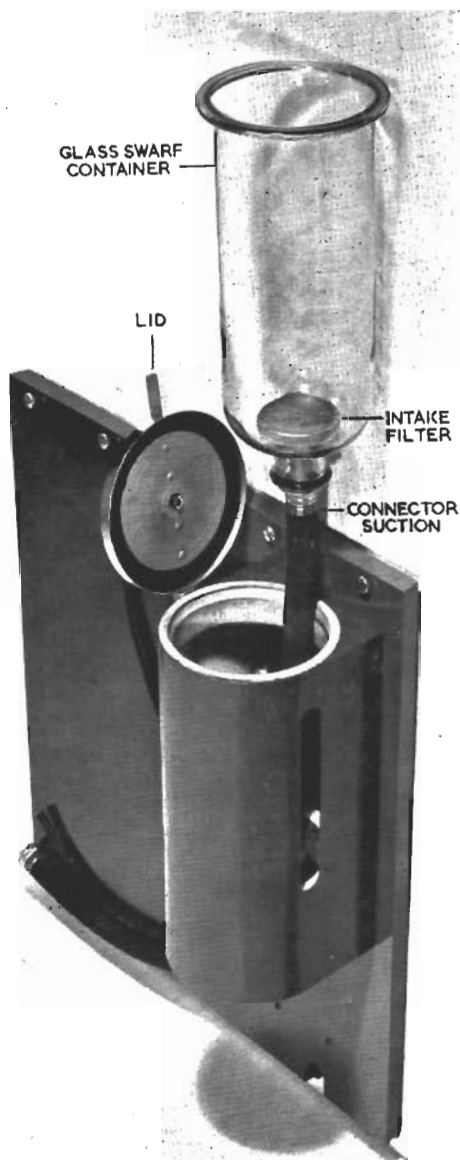


Fig. 16. Swarf Container Assembly

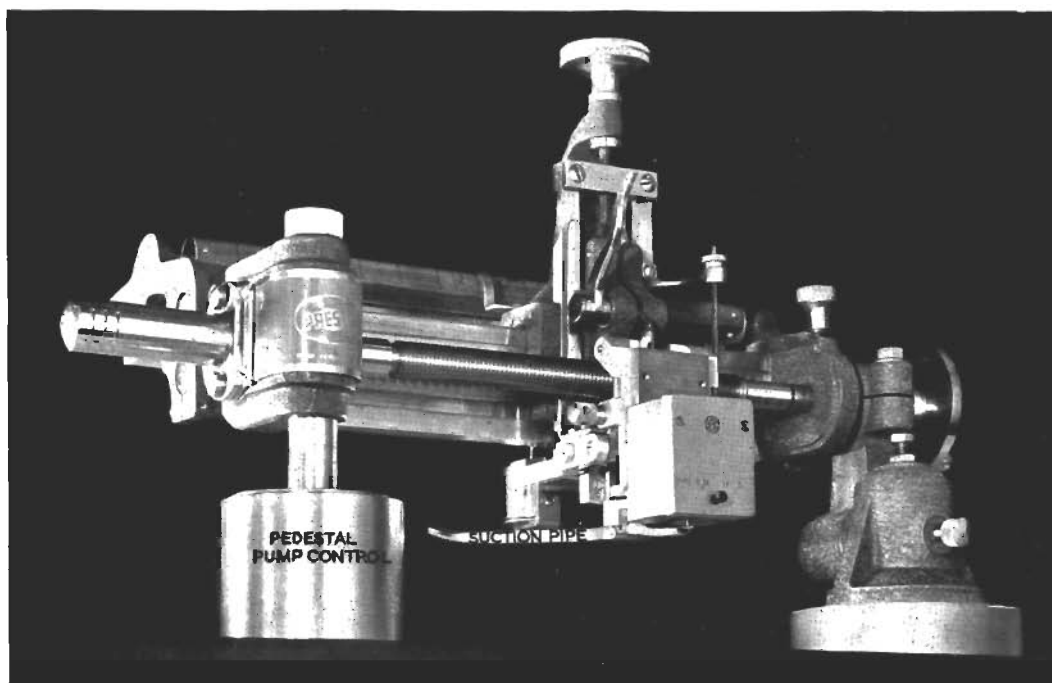


Fig. 17. Type-8NA Traversing Assembly  
Showing Suction-pipe and Pedestal Pump Control

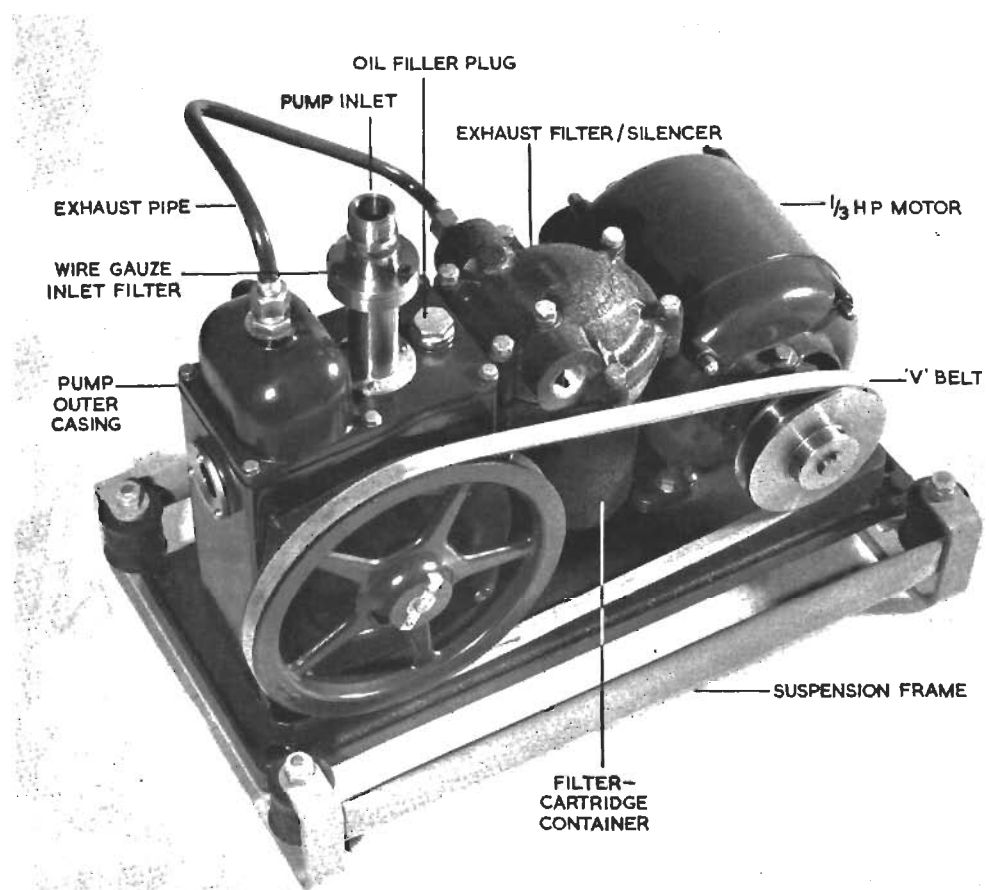


Fig. 18. Pump and Filter Silencer Unit

| ISS | CHANGE                        |
|-----|-------------------------------|
| 2   | TEST<br>RECORD WAS<br>XTR 311 |

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